The health legacy of the European coal mining regions: The role of socio-economic context and individual life course histories of the over 50's in influencing regional health differences

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ABSTRACT

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This study looks into the health legacy of a selection of European coalmining regions, comparing the health of survey respondents over 50 years of age living in coalfield regions to those living in non-coalfield regions. A review of literature in the field suggests that regions characterised by a history of coalmining and subsequent de-industrialisation are often associated with poor population health outcomes, compared to non-coalfield regions. The reasons for this are complex, but are associated with country and regional social and economic characteristics impacting on individual social and economic characteristics through psychosocial processes which influence individual behaviour and lifestyles and bio-chemical responses to stress. Drawing upon data from two harmonised European surveys of people aged fifty years and over: The *Survey of Health and Aging in Europe* (SHARE) and the *English Longitudinal Study of Aging* (ELSA); combined with data covering country and regional contextual factors from Eurostat's General and Regional statistics database; this study identifies if there are differences in health between individuals living in coalfield regions and non-coalfield regions in European countries. Individual demographic, socio-economic and health risk characteristics are examined to see how far they can explain any health differences between coalfield and non-coalfield regions. The study goes on to assess country and regional contextual socio-economic, environmental and political factors which could help the understanding of the reasons behind health differences between coalfield and non-coalfield regions, and between coalfield regions between countries. Using logistic regression, interpreted in light of a qualitative assessment of some selected literature sources, the findings confirm an underlying general 'coalfield health effect' after controlling for individual characteristics, but one which varies between countries and which suggests the role of national and regional economic conditions and policy directives play a role on influencing health inequalities between coalfield and non-coalfield regions.

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Table of contents

List of tables

List of figures

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CHAPTER 1

1.1 Background to the study

This dissertation reports on research which explores whether and how the health of individuals varies in relation to characteristics of their area of residence, as well as in relation to their individual attributes. I have chosen to investigate whether the health of individuals living in different parts of Europe is associated with living in areas with a socio-economic legacy of coalmining.

As illustrated in the review of the literature below, there has been for some time a growing interest in how socio-geographical processes relate to public health outcomes, and the associated links between economies and health. Understanding the links between industrial legacies and health is important for policy development in relation to regeneration and redevelopment of areas affected by deindustrialisation.

Section 1.2 of this chapter reviews the literature on population health disparities and covers the theories of health inequalities, expanding on the life course approach to health inequalities and how it is relevant to the research covered in this dissertation. The literature review also covers the influence of coal mining and post-industrial legacy on health and the complexity of the relationship between individual and contextual factors in influencing health outcomes.

Chapter two covers the study's conceptual framework, hypothesis, research questions and objectives. In chapter three the method of selection of the European coalfield regions is covered and the three major sources of data for the study are introduced: two harmonised European longitudinal panel surveys of people aged fifty and above and the Eurostat's General and Regional statistics database. The individual and contextual variables are introduced, with the rationale for their selection being cross referenced to the study's conceptual framework.

Chapter four covers the statistical methods used in the study: multivariate logistic regression. It goes on to cover a preliminary investigation of the data carried out to test the statistical strength of observed differences in reported health between individuals living in coalfield and non-coalfield regions, through bivariate analysis.

Chapter five explores the role that national context may have in influencing the variation in health outcomes of individuals. It illustrates the interaction between country and coalfield region, which shows country differences in the association between coalfield region and health outcome. Possible cultural differences in responding to health survey questions are also discussed and investigations are made to identify if any were detectable in the study's data.

Chapter six investigates how far the chosen individual variables were able to explain health outcomes for each of the countries in the study; carried out through bivariate analysis, of the health outcome variables and each of the individual predictor variables measuring demographic, social-economic and health risk factors. The analysis then went onto investigate how far the individual factors helped to account for the hypothesised coalfield effect on health outcome. This was done by using multivariate logistic regression analysis to assess the combined impact of the individual demographic, socio-economic and health risk characteristics on the likelihood of reporting poor health outcomes.

Chapter seven covers the final stage of data analysis, which investigated if regional contextual characteristics of coalfield regions could help understand the reasons for any coalfield effect on health outcomes. This was done through graphical assessment of coalfield regional contextual characteristics against national averages, set against the theoretical background of health inequalities and the wider determinants of health.

Chapter eight covers the discussion of the results and how far they were able to answer the study's research questions. It also covers discussion of findings from a qualitative assessment of two literature sources and the graphical presentation of the study's contextual data from the Eurostat database.

Chapter nine concludes the dissertation by stating how the study contributes to the literature and gives recommendations for policy. It points out the study's short comings and methodological limitations and suggests possibilities of future research.

1.2 Review of the background literature

This research is situated within a wider literature on regional and individual health inequality. The health differences across the English regions are well known. The report of the working group on health inequalities, the Black Report, published in 1980 by the then Department of Health and Social Security, showed in detail how the extent of ill health and death were unequally distributed within the population. The English Health profiles, published annually by the Association of Public Health Observatories since 2006, today show how these inequalities persist. Health, as measured by mortality and life expectancy, is generally worse across the northern regions of the North East, North West and Yorkshire and the Humber, than across the regions of the East, South East and South West. The Black Report suggested these health differences were associated with social inequalities in factors which influenced health: income, education, housing, employment and diet. Today the debate on health inequalities has developed this idea and is now firmly framed in terms of the social determinants of health, (Marmot et al. 2010).

A number of different, but not totally mutually exclusive theories have evolved to explain the existence of health inequalities (reviewed for example by Bambra (2011) and Kawachi (2002). The *material* interpretation emphasises the relationship between differences in socio-economic position and in material conditions of home and work, or of goods and services. The *psychosocial* interpretation suggests that the psychological stress of being relatively deprived is a mediator for the effects of stressful living and working conditions, and feelings of lack of control and low self-esteem which may be associated with increased uptake of health risk behaviours such as smoking and excess drinking. The life course interpretation takes a number of aspects from the preceding theories and examines how the accumulated effects of exposure to negative and positive processes and life circumstances during pre-natal, childhood and young adulthood, accumulate risk and resilience to influence health in adulthood.

These theories seek to explain health inequalities between different groups of people. But how much are health differences between people influenced by the contextual effects of places within which people live? Are differing levels of health between areas the result of differing distributions of types of people whose individual characteristics influence their health? Or are they due to environmental, social, economic, political and cultural processes within places which influence individuals, via the pathways suggested through the theories of health inequalities, and give rise to geographical differences in population health?

This study investigates these questions by analysing the health of individuals living in 'coalfield' regions and 'non-coalfield' regions, in seven European countries. The working definition of a coalfield region used in this research is described in detail in the Methods chapter below, but briefly, 'coalfield' regions were identified as areas having a history of coal mining (which in many coalfield areas has subsequently declined and has gone through, or is still going through, a period of post-industrial change). Examples of these coalfield regions include the North East of England, one of the English regions characterised by poor health, with deprivation brought on by post-industrial economic and social decline being one of the main reasons for this; and coalfield regions across Europe, for example the Ruhr in Germany and the coalfield regions of Belgium and France, which have also have gone through post-industrial restructuring, (Siorack 2006). Also included are areas such as the Eastern European Upper Silesian coalfield region, which spreads across areas of the Czech Republic and Poland, perhaps less de-industrialised, but still having gone through a coal industry decline.

1.2.1 The influence of coal mining and a post-industrial legacy on health

The effects of coal mining and industrial decline and subsequent social and economic deprivation on health have been investigated and reported on elsewhere. Studies have shown that health is worse for the population of coalfield areas in the United Kingdom than other parts of the country and point to a number of different factors which could account for this.

Hart (1971) points to the wider determinants of health in explaining differences in health when comparing the health of Welsh miners and mining communities with that of the general population of England and Wales across a number of health markers and chronic illnesses affecting employability of men. The study found that there was excessive mortality and morbidity among miners and that the health of mining populations was getting worse relative to that of England and Wales as a whole. The reasons for this were put down to differences in income, housing, education and social amenity within the mining communities.

Other authors point to illnesses that may relate to industrial exposures which may explain the worse health in coalfield areas. Coggon et al. (1995) for example found that there were high rates of chronic bronchitis and emphysema in coal miners compared to other occupations. The study also suggested that, as there was no geographical correlation between pneumoconiosis and bronchitis and emphysema, it was differences in the characteristics of coal mine dust which influenced the development of the two diseases. The higher prevalence of pneumoconiosis was associated with coal miners who worked high rank coal. This is an interesting finding, suggesting that different coal mining areas could have different disease patterns, as a result of the type of coal mined.

Some studies suggest that there is a damaging legacy for present day health of longer run economic deprivation and decline. Riva et al. (2011) mention that through the 1970's, '80's and '90's, many European countries saw large scale de-industrialisation and restructuring of regional economies, which resulted in unemployment and economic and social decline. Areas affected by de-industrialisation are often characterised by poor health and deprivation, which in some cases has lasted many years after the end of economic change. Curtis et al (2004) suggest that deprivation associated with the most recent de-industrialisation changes have combined with the health impacts of previous social and economic events in the 1930's, which are shown to have a relationship with health outcomes (mortality and long term illness) among older people who lived in economically depressed areas when they were young. This suggests that prior industrial conditions leave a legacy, which combine over the life course, to have an effect on health of individuals having lived wholly or partly in these areas.

Walsh et al. (2008) compared trends in mortality in Scotland, in particular West Central Scotland (WCS), with other similar regions in Europe and found that mortality rates for these regions tended to be the highest, or among the highest, for their countries. However, in WCS the rates appeared to be improving at a slower rate than other post-industrial regions with similar levels of deprivation (Walsh et al. 2010). This suggests, for WCS at least, that poor health is not being caused by present day post-industrial poverty and material deprivation alone. Could it also be a consequence of how the longer term industrial legacy, the culture of the region, and the ways that economic disadvantage is managed by social and economic policies of governance?

Other studies discuss the implications of the economic demand for coal and coalfield and industrial regeneration policies in not addressing health and health inequalities of coalfield areas. Morrice and Colagiuri (2013) discuss the competing aspects of the continuing demand for coal worldwide and the social, environmental and health injustices which accompany the industry within the communities it influences. They cover the health harms of the people living in communities next to coal mining caused by particulate matter and toxins in air pollution. They list the negative physical health effects from respiratory complaints, cancers, heart disease and excess deaths; but also mention psychological distress related to adverse environmental and social change caused by feelings of powerlessness and loss of attachment to place, when communities are influenced by industrial decline. They argue that health is overlooked in the quest for economic benefits and the power the industry has over the local communities it resides in, and that the evidence of health harm caused by mining is not being considered appropriately in public debate and policy making.

Shucksmith et al (2010) look into the regeneration of former coalfield areas in England and ask if health has been overlooked, where successive waves of regeneration activity have concentrated on finding new jobs and fixing the environmental cost of economic and social harm caused by industrial decline, rather than addressing the health inequalities found in these former coalfield areas. They suggest that these health inequalities should be addressed by direct action through partnership working at local level between health and social care and need to address such areas as improving social housing, improving education attainment and skills, and improvements in early years support for children and families, with specific targeting of the more vulnerable and disadvantaged communities. However, they also show that there is considerable variability between coalfield areas in their response to regeneration activity. They showed that comparisons between different coalfield regions identified differences in health, for example, rural coalfield area fared worse that urban coalfield areas.

1.2.2 The complexity of individual and spatial interaction on health determinants

Although the Walsh et al. study (2008) concentrates on post-industrial decline across Scotland, the area of WCS has been influenced by the Scottish Central coalfields, and raises a question over what factors, other than general deprivation, could be influencing the apparent differences in health between the deprived areas of WCS and other similar regions within Europe (Walsh et al. 2010). It is this debate relating to the interaction of individuals with their social and economic environment to which this study aims to contribute.

Previous studies have illustrated that these interactions are complex. Mitchell et al. (2000) report that the degree of de-industrialisation which an area has experienced has an association with the health of residents, which is independent of their individual characteristics; and that the relationship between a person's attitude to their community and their health, is independent of individual and area characteristics; they conclude that both individual and area characteristics influence health.

Wiggins (1998) found that individuals' experience of disadvantage over time affects the risk of limiting long term illness, but geographical differences are not entirely explained by the distribution of individual characteristics; persons with similar individual histories may face a different risk of illness in different kinds of region. Health selective migration (Norman et al. 2005; and Boyle 2002), is another way that individual attributes can contribute to area differences in health, as people move to more or less disadvantages areas, in ways that are not independent of their state of health and individual health determinants. Curtis and Jones (1998) outline different concepts of space and place, and state that geographical settings, as well as individuals, have a role to play in shaping health differences between people.

Studies so far give mixed results and illustrate the complexity of the issue in searching for an answer as to why different places have differing health. This applies however health is measured, by subjective self-reported health or by objective mortality and life expectancy. Trying to identify explanations for these mixed results, authors have put forward suggestions on how to improve studies designed to take into account the complex nature of the determinants of health.

Cummins et al. (2007) say that relational views of place and space should be taken into account when researching health variation between places, so as to avoid polarising the ideas of context and composition, resulting in an underestimation of the contribution of place to disease risk. The relational view allows mutually reinforcing and reciprocal relationships between places and people to be acknowledged. Macintyre et al. (1993), in their review of the literature on the relationship between place and health, propose the direct observation of social environmental features of place that might promote or harm health, rather than relying on area measures based on aggregated features of individuals from surveys to describe a place. Macintyre et al. (2002) suggests studies on place effects have been data driven, and highlight a lack of appropriate conceptualisation, operationalisation and testable hypotheses about the mechanisms by which place could influence health. They discuss weaknesses in viewing context and composition as being mutually exclusive and suggest the use of a conceptual framework of universal human needs as the basis for thinking how places may influence health, and by which to build a set of measures to describe place. They suggest the conflicting evidence about the degree of area effects on health may be due to differing conceptualisation and operationalisation of area effects in analyses, in particular the ways that characteristics of individuals or places are seen as confounding or intervening variables. They also say that it should not be assumed that similar area effects will be operating for all spatial scales, time periods, population sub-groups or socio-economic and cultural contexts.

It seems that the differences in health between settings are a function of both individual characteristics and contextual economic, social, cultural and environmental factors and that the causal interactions between individuals and places are complex.

1.2.3 The life course approach to health inequalities

Chapter six of the Black Report (1980) had a major role in putting forward theoretical approaches to explain health inequalities. The Acheson Report (1998), adopting the socio-economic model of health, illustrates in their figure 2 on page 111, how different exposure during the life course to risks associated with socioeconomic position influences health. Bambra (2011) briefly outlines the most widely cited theories: cultural-behavioural, materialistic, psychosocial and the life course. Although distinct, these theories are not mutually exclusive and they cover explanations for a range of processes producing differences in health behaviour and lifestyle between social groups: the role of socially defined culture and social norms, of psychosocial pressures associated with lower social position, of individual psychological characteristics in influencing lifestyle 'choices', to material disadvantage in explaining the reasons for differences in health behaviour.

The life course perspective takes into account the neo-materialist, psychosocial and cultural-behavioural theories, and considers the interrelationships between social, political and cultural aspects of the context in which individuals are located over time. Bartley (2009), and Blane (2008) discuss the life course approach, and show how it can be used to explain how health outcomes are the result of a number of interacting social, biological, behavioural and psychological circumstances of advantage and disadvantage, operating over time through different life stages: gestation, childhood, adolescence and young adulthood; to influence individual development and functioning and subsequent health and socio-economic position in later adult life, thus accounting for social inequalities in adult health and mortality.

There are a number of different conceptual life course models which show how social, economic, biological and psychological factors at different life stages may operate via: accumulation of risk, chains of risk and risks during critical periods; as described by Kuh et al. (2003). They discuss how socio-economic factors at different life stages may operate via social chains of risk, or by influencing exposures to causal factors at earlier life stages, which form part of long term biological or psychological chains of risk. A chain of risk refers to a sequence of linked exposures that increase (or decrease) disease risk, whereby one negative (or positive) exposure tends to lead to another and another; thus helping to explain the pathways between early life experience and adult psychosocial function. Ben-Shlomo and Kuh (2002) discuss how many potential biological, behavioural, social and psychological pathways operate across an individual's life course to influence health outcome, specifically in the case of respiratory disease.

Bartley (2009) comments that the life course approach regards patterns of health inequality as being affected by the positions of individuals in social and economic structures, and goes on to say that the social patterning in society is dependent on the political and cultural environment, the processes associated with the political economy of health; and examines the ways in which economic and social policies influence the accumulation of material and psychosocial risk over the life course.

The arguments above suggest that a life course approach provides an ideal context in which to frame this study, with the idea that there are complex interactions of structural, behavioural, psychosocial and cultural factors operating at different points in the life course and mediating the relationship between industrial decline and relative poor health. That health in later life is a function of the accumulation of past experiences, and as discussed in Macintyre et al. (2002), this should be taken into account in a study investigating the significance of place or individual factors in accounting for health differences between settings. It is important, therefore, to consider exposure to health risks in the past as well as the present in order to understand inequality in health at any particular time.

1.2.4 Conclusion

The review of the literature suggests that population health may be different in coalfield to non-coalfield areas due to individuals' life time exposures to combinations of environmental, social and economic processes which are distinctive to coalfield regions. The next chapter expands on this idea through the development of the study's conceptual framework.

CHAPTER 2

2 Conceptual framework and research questions

In light of the literature reviewed above, contextual health differences can be interpreted as the result of complex interactions between historical and current; social, economic and cultural characteristics of places, and resultant life time psycho-social and behavioural processes operating on individuals who live with those places.

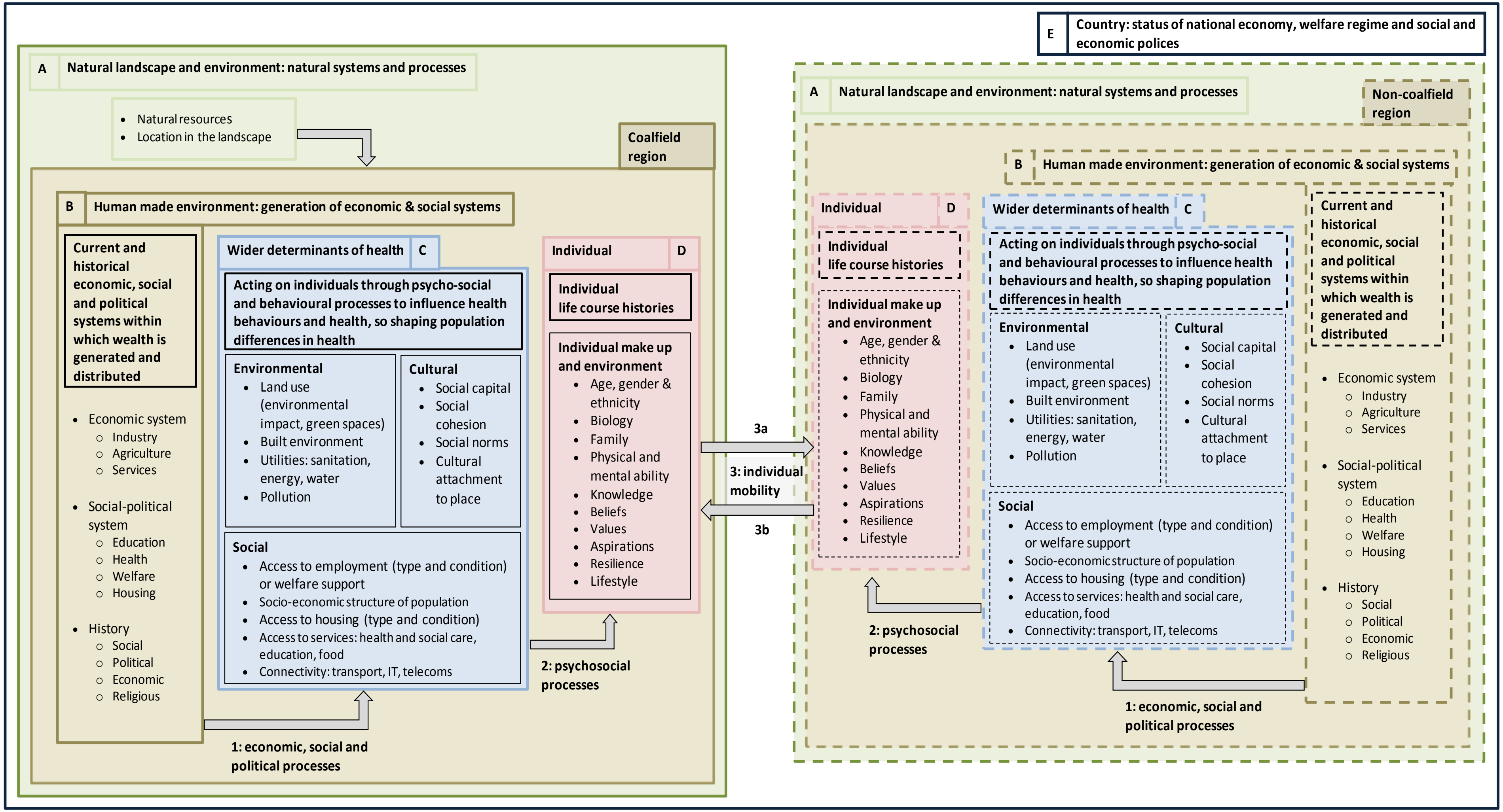
The aim of this research is to examine some of the individual and contextual social, economic, political and cultural factors, which may contribute to health differences between coalfield regions and non-coalfield regions across Europe. This chapter presents in more detail the conceptual framework for this study and the research aims and objectives.

2.1 Conceptual framework

The conceptual framework for this study is presented in figure 1, which represents sets of processes operating in two hypothetical places within a country, one a coalfield region and the other a non-coalfield region and the interconnections between them through processes such as health selective migration, and the national setting in which both are located.

Places are defined by their geographical attributes of location in the landscape and access to natural resources (A in figure 1). These varying assets have been utilised by people and have subsequently helped to shape the local economic, social and political histories of places we see today (B in figure 1).

Figure 1: Conceptual Framework: A relational perspective on the generation of health differences between places



The economic activity of a place, with the amount of wealth it generates and the social-political system within which it operates, will influence the contextual characteristics of a place (pathway 1 in figure 1): the natural and built environment, quality of housing, access to education, health services, leisure opportunities, available green spaces, transport infrastructure, quality of the environment, social support and social norms. These can be seen as the wider determinants of health (C in figure 1) and will act on individuals (D in figure 1) via biological, psycho-social and behavioural processes (pathway 2 in figure 1). Regions that are more socially and economically advantaged (non-coalfield region in figure 1) are also more likely to be more attractive to people who are residentially mobile and have a choice of where they live, so more advantaged areas will see net inward migration (pathway 3a in figure 1). On the other hand, areas which are more socially and economically disadvantaged (coalfield region in diagram 1) will see net outward migration (pathway 3b in figure 1).

This research therefore aimed to explore how far it would be possible to include indicators of area conditions that would be suitable proxies of natural environment and resources, local economic conditions and wealth, attributes of regional housing, education and health care provision and services. The literature on health in coalfield regions in the UK suggests that these will differ from other 'non-coalfield' areas in the form of poor environmental impact brought on by the mining industry; unemployment, economic and social deprivation brought on by coalfield industrial decline and economic restructuring; poorer health brought on by the health damaging effects of mining work and through the wider determinants of health. Potential assets associated with coalfield contexts are the strong collective tradition of solidarity around the work place and strong social cohesion and support within local communities.

Social-political systems help shape the contextual characteristics of a place (B in figure 1) and so influence (through pathway 1 in figure 1) the nature of the wider determinants of health operating in different places (C in figure 1). Eikemo et al. (2008 - 2) investigated the extent to which welfare state regime classification explained between country differences in self-perceived health in Europe. They reference studies which indicate that welfare states are important determinants of health in Europe, through the mediating factors of welfare provision. This research aimed to include information about the national context in which regions are located (E in figure 1).

These processes will operate throughout an individual's life course through circumstances of advantage and disadvantage, affecting individual health through accumulation of multiple risks and chains of risk and resulting in differing health consequences for different groups of individuals. Generally places characterised by a weakened economic base, will have greater economic and social deprivation, which in turn generates greater risks for individuals to experience poor health. Individuals who have weakened personal resources to cope with the economic and social determinants of health will also be at greater risk of experiencing poor health. The research therefore aimed to include some information about previous place of residence and personal life history of the individuals considered here.

Both the natural and economic environments vary in type and character between places, producing a hierarchy of places, which can be expressed in terms of a ranking according to the principle economic base of wealth production of each place (the coalfield region and non-coalfield region in figure 1). There are also social hierarchies of places, as defined by the socio-economic make-up of the individuals who inhabit them. The well-known relationship between socio-economic position and health helps to explain how regions with better population health will be those which have the most opportunities for individuals to be employed and earn higher incomes through wealthier economic and social systems. The economic structure of a place also determines how attractive or accessible it is for individuals in different socio-economic positions. Places that are unable to attract 'wealthier' (and 'healthier') jobs will not be able to attract the associated 'wealthier' and 'healthier' individuals (resistance in pathway 3b in figure 1). These areas will be at a greater disadvantage with regards to acquiring human resources to support the economic function and the ability to foster the right environment to influence positive individual health behaviours to foster better population health, Norman et al (2005). Also, individuals who are disadvantaged may be 'trapped' in disadvantaged areas (resistance in pathway 3a in figure 1), or tend to migrate towards them because they offer more affordable housing or lower paid jobs demanding fewer skills or qualifications (self-selection operating in pathway 3b). These processes affect the composition of the population in different places, and also contribute to individual health and resilience and future ability to be both socially and geographically mobile. Those individuals who are able to keep or achieve a higher place in the social hierarchy locally, or who are more able to change their geographical location to improve their prospects because of better health, will be in a better position than those who are socially and geographically immobile, due to poor health or lack of employment opportunities, especially at the lower end of the social spectrum, (Norman et al. 2005; Boyle 2002). While in this study it was not feasible to examine residential mobility in detail, it considered length of residence in an area, to reflect length of exposure to local conditions.

2.2 Research questions

In light of the literature review above, the questions the study aims to answer are:

1 Are there differences in health between individuals living in coalfield regions and non-coalfield regions in European countries; and if so are these differences consistent across countries?

   This question will explore whether the survey data used in the study can detect differences in self-reported health and self-reported long standing illness between individuals living in coalfield and non-coalfield regions and if any differences detected are consistent across European countries.

2 How far do individual demographic, socio-economic and health risk characteristics explain health differences between coalfield and non-coalfield regions?

   This question will explore how far area differences in self-reported health and self-reported longstanding illness may be associated with certain demographic, socio-economic and health risk characteristics of the individuals living in coalfield and non-coalfield regions.

3 To what extent can contextual, socio-economic, political and environmental factors help explain health differences between coalfield and non-coalfield regions, and are there variations between countries in these associations, which may relate to national political and economic conditions?

   This question will examine whether and to what extent socio-economic, political and environmental characteristics of coalfield areas may contribute to health outcomes of individuals living in these areas.

CHAPTER 3

3 Methods

Based on the theoretical framework explained above, this research explores whether individuals currently living in European coalfield regions have poorer health than individuals living in non-coalfield regions within their countries, as is the case for residents in the North East of England and some other English coalfield regions. To do this it draws upon data from two surveys; The *Survey of Health and Aging in Europe* (SHARE) and the *English Longitudinal Study of Aging* (ELSA), combined with data covering regional economic and social factors. In this section the methods used to prepare and analyse these data are described.

Below are explained the sources and definitions of information and operational processes used in this research. Indicators describing individual health outcomes and life course health determinants are taken from two harmonised European longitudinal panel surveys of people aged fifty and above. Indicators describing contextual economic and social characteristics of regions are sourced from Eurostat's General and Regional statistics. Eurostat is the statistical office of the European Union and is tasked with providing the European Union with statistics at European level that enable comparisons between countries and regions.

Also explained below are the analytical techniques used for the analysis. This study uses multivariate logistic regression, qualitative data comparisons and a short qualitative assessment of two data sources, to investigate differences in health between coalfield regions and non-coalfield regions across Europe.

3.1 Identification of coalfield regions

The 'coalfield' regions have been identified on the basis of a shared history of coalfield decline and post-industrial change; although not all regions have experienced decline and change to the same degree. For example, there are now no coalmines operating in France, the last mine closed in 2004, ending a period of coal extraction that started in the 19th century. While a year earlier in 2003, mining still employed 21 000 people in the Czech Republic, with their average salary being higher than the national average, although coal production was at an all-time low at the time.

Due to lack of available comparable data on local economic activity in the 1980s, it was not possible to identify coalfield regions for the study using an analytical approach, similar to that described in Beatty (1996). Beatty's definition of coalfield regions was made by identifying regions where more than 10% of the workforce had been employed in mining and quarrying during the 1980's. The identification of coalfield regions for this study instead rested on a set of other criteria.

The selection of the countries and regions for this study was based on the following technique. Initially a geological map was used to identify where the underlying geology of the northern coalfields of England occurred in other countries across Europe. The geology of the Carboniferous sequence of limestone, sandstone and coal measures was traced east into Europe forming the Nord pas de Calais and Lorraine coalfields in France; the Limburg and Peel coalfields in the Netherlands; the Borinage, Centre, Charleroi, Liege and Kempen coalfields of Belgium; the Rhur and Saar coalfields of Germany and the Silesian basin coalfields of Poland and the Czech Republic. The Carboniferous geology also extends south, forming the Guardo and Nalon coalfields of Northern and Central Spain. This qualitative method of coalfield identification was backed up by two literature sources: first Walsh et al. (2008) identified regions in Europe, which were similar to that of the West of Scotland, by being industrialised and having undergone a process of deindustrialisation over recent decades. Although Walsh and colleagues did not concentrate solely on coalfield regions, a number of their regions, chosen through a consultation with experts in the fields of economic history and public health, had a coal mining history and matched the coalfield regions identified for this study. The second work referenced was Siorack et al. (2006) report. This report covers an inventory of mining areas in Europe covering the UK, France, Germany, Spain, Poland and the Czech Republic, together with statistics on the socio-economic characteristics and the changing levels of mining activity of each area. The coalfield regions identified for this study were mentioned in this report.

Once the extent and location of the coalfields had been identified on the basis of geology, the next stage was to identify associated administrative regions which could be overlaid on top of the geologically defined coalfield areas. This would allow the sources of individual characteristics from the surveys and the contextual regional socio-economic data from other sources, to be linked with the identified coalfield areas. The administrative geography chosen were the 'NUTS' (European governmental acronym for 'nomenclature of territorial units for statistics') areas. This is a hierarchical administrative classification used for dividing up the economic territory of the European Union for the purpose of the collection and harmonisation of European Union regional statistics. NUTS 1 are the highest geographical level and represent the major socio-economic regions of a country, covering a maximum population of 7 million and a minimum of 3 million. Regions at NUTS 2 level (at a finer geographical scale) are most often used for the application of regional policies, covering populations between 800 000 and 3 million. NUTS 3 are the lowest and smallest NUTS geographical level covering populations between 150 000 and 800 000. Maps illustrating the boundaries at each of the NUTS levels can be found on the Eurostat Website (http://ec.europa.eu/eurostat/web/nuts/statistics-illustrated, accessed 30/09/2015). For all of the European mainland countries within this study, the NUTS geographies correspond to the country's classification of administrative regions. However, for the countries of the UK, the NUTS classification bears little resemblance to current administrative geographies, with only the NUTS 1 regions corresponding to the Government Office Regions for England. Although the NUTS classifications are the same across all European countries, there is large variation in the size of the population and geographic area of similarly classified regions.

The data in the Eurostat database and the two surveys immediately limited the scale of the geography for the study to NUTS 2 level. This was because these are the units for which regional contextual data are available in Eurostat's 'General and Regional Statistics' database, and to which the associated individual information in the SHARE and ELSA surveys relate.

The final stage in the process of attaching a NUTS 2 administrative geography label, to the coalfield regions identified above, was to overlay the NUTS 2 regional boundaries over the geological extent of the identified coalfields. The constraint of the choice of NUTS 2 geographies resulted in the identified 'NUTS 2 coalfield regions' containing a mix of local areas not all of which were characterised as lying within the identified coalfield areas, resulting in some diluting of both the contextual and individual characteristics which could be markers of an area having a coalfield history. These approximations have the potential to cause a degree of inaccuracy in the analysis presented here. Individuals from the survey may be allocated to a coalfield region, when in fact their location of residence and life has been shaped largely by non-coalfield social and economic processes; resulting in the individual characterises, which could help explain differences in health outcomes between coalfield and non-coalfield regions, being hidden. Social and economic contextual factors at NUTS 2 level which are used to describe coalfields, may underestimate true coalfield effects, as they are moderated by more positive social and economic factors associated with non-coalfield regions.

There were additional issues for the Belgian, French and Netherland geographies. For Belgium the SHARE data were not available at the preferred NUTS 2 level. This meant that there were only two survey regions available for comparison, covering the higher NUTS 1 level regions of Wallonia and the Flemish Region. However, the two identified NUTS 2 level coalfield regions do fall wholly into Wallonia, and have a strong influence on the nature of the region as a whole. For France, although the regions surveyed for SHARE were at NUTS 2 level, not all regions at this level were surveyed, only one NUTS 2 level region from each of France's NUTS 1 level regions was chosen for survey. Both of the regions associated with France's coalfields had been surveyed, Nord Pas de Calais and Lorraine. However, it was decided to drop Lorraine from the study as the region was not represented by a large enough sample size. Due to the survey regions in the Netherlands not corresponding to the NUTS area classification used by Eurostat, no regional data could be obtained for the Netherland regions and so the country had to be dropped from the study. It is worth pointing out that the French region of Nord Pas de Calais is dually classified at both the NUTS 1 and NUTS 2 levels. The Czech Republic region Moravskoslezsky is also dually classified at NUTS 2 and NUTS 3 level. Table 1 contains the selected level, name and population of the NUTS geographies used in the study, together with their associated geologically classified coalfields.

Table 1: Study coalfield regions and countries

Country	**Coalfields**	**Region NUTS level**	**Coalfield Region Associated Geographies**	**Population (2007)[1]**
Belgium	Borinage, Centre, Charleroi, Liege, Kempen	1	Wallonia (Liege, Hainaut)[2]	3, 435, 879
Czech Republic	Ostrava-Karvina	2	Moravskoslezsky[3]	1, 243,309
France	Nord Pas de Calais, Lorraine	2	Nord Pas de Calais[4], Lorraine	4, 021, 676 2, 339, 881
Germany	Rhur, Erkelenz, Aachen, Saar	1	North Rhine Westphalia, Saarland	18, 028, 745 1, 043, 167
Netherlands	Limburg, Peel	2	Limburg	1, 127, 805
Poland	Lower and Upper Silesia, Lublin Basin	2	Dolnoslaskie Slaskie, Lubelskie	2, 882, 317 4, 669, 137 2, 172, 766
Spain	Nalon, Guardo (Leon, Palencia)	2	Aragon Principo de Asturias Castile and Leon Castile la Mancha Galicia	1, 294, 243 1, 065, 287 2, 514, 206 1, 971, 208 2, 741, 074
England	North East, Yorkshire, Midlands	1	North East, North West, West Midlands, East Midlands, Yorkshire and the Humber	2, 557, 242 6, 915, 555 5, 433, 639 4, 385, 722 5, 149, 113

1: Data source: Eurostat General and Regional Statistics data base. 2: NUTS level 2 regions of Belgium. 3: Czech Republic region dually classified at NUTS 3 level. 4: French region dually classified at NUTS 1 level

3.2 Selection of regional contextual measures

Data covering regional context come from Eurostat, the statistical office of the European Union situated in Luxembourg. Eurostat supports and co-ordinates the collection of comparable national and regional data from the statistical agencies of individual European countries. The data collected cover topics such as health, society, economics, labour force, industry and population, and are made available through online tools, analysis and reports. Data for this study were extracted from the 'General and Regional Statistics' database, (http://ec.europa.eu/eurostat/data/database, accessed 30/09/2015).

Ideally the contextual characteristics should have been studied over time, to enable detailed economic and social histories to be developed for each region. However, because of incomplete regional data across countries for the population at risk of poverty and heavy environmental impact land use, cross-sectional data had to be used for these indicators; the year 2009 was closest to the survey field work years for which the data were complete for all regions in the study (ELSA 2006/2007 and the SHARE 2008/2009). In countries where trend data did exist, disappointingly, the data were only available within the database going back to 2000, which restricted the possibilities of a strong historical analysis.

National contextual data was used as benchmark for the coalfield regional contextual data. Geographical boundaries used to delineate the national context were in general the national borders of the countries considered here, and national contextual information on aspects such as gross domestic product (GDP) related to these national units. However, contextual data for England, as a country distinct from the UK as a whole, were not available from the Eurostat database, so the English coalfield region contextual data had to be compared with data representing the UK (England, Scotland, Wales and Northern Ireland).

With reference to the conceptual framework covered in chapter two, indicators were selected to describe regional context in terms of social, economic, political and environmental factors which may influence the nature of the wider determinants of health operating on the individuals who live within the regions.

As covered in chapter one and represented diagrammatically in the conceptual model (figure 1), places are defined by their mix of economic resources (A in figure 1). These resources influence the development of socio-economic hierarchies between places, as well as between individuals within places, and are defined by the level of economic production of wealth within each place. Gross domestic product (GDP) per inhabitant was the indicator chosen for the study to reflect the wealth of each region. Other indicators which could reflect the social and economic structure of places were also investigated; an indicator was identified which could have covered the proportion of the population employed by economic activity, as classified by the statistical classification of economic activities in the European Community, NACE (derived from the French 'Nomenclature statistique des activitiés économiques dans la communauté européenne). Another indicator was identified which could have been used to reflect the social structure of a place (ISCO08 – International Standard Classification of Occupations). However, neither could be used as data were not available for all regions in this study.

Regions with a weakened economic base will experience a reduction in the quality of their natural and built environment, and social deprivation will become more apparent. The percent of land use given over to land uses with heavy environmental impact (as opposed to agriculture, forestry, services and residential) was chosen as an indicator of land deprivation and poor environmental quality. The percent of population at risk of poverty (for definition see appendix 1) was selected as an indicator of household income deprivation, a marker for social deprivation.

As mentioned above, the social, economic, political and cultural history of a place (B in figure 1) will have an influence (through pathway 1 in figure 1) on the nature of the wider determinants of health operating in that place (C in figure 1). Differing public policies and welfare state regimes have the potential to influence the health of individuals through the way they shape the socio-economic environment in which people live (B in figure 1), which in turn influences the psycho-social and behavioural processes acting on individuals (via pathway 2) through the wider determinants of health (C in figure 1). The nature of the different welfare state regimes are introduced and discussed in Eikemo et al. (2008), and a summary of welfare states of different countries is given, based on a classification of 'decommodification' (the extent to which individuals and families can maintain a normal and socially acceptable standard of living), social stratification and the private-public mix of welfare provision (the roles of the state, family, voluntary sector and the market in welfare provision). The classification is summarised here in table 2 and allocates each of the countries within the study to their welfare state regime.

Table 2: Classification of welfare state regimes (adapted from Eikemo et al (2008)

Welfare state regime	Brief regime description	Country allocated to regime
Anglo Saxon (Liberal)	State provision minimal, social transfers modest with attached entitlement criteria. Minimises decommodification effects of the welfare state. Characterised by sharp divisions between the more well off and the more needy	UK - England
Conservative	Benefits are often earnings related and geared towards maintaining existing social patterns. The role of the family is emphasised.	Germany France Belgium
Southern	Fragmented system of welfare provision consisting of diverse income maintenance schemes offering small to generous support. Health care support provides limited and partial coverage. Reliance on family and voluntary sector.	Spain
Eastern	Experienced extensive social reforms after the fall of communism. Seen the demise of universalism and a shift towards the Anglo Saxon/Liberal regime, but have limited health service provision.	Czech Republic Poland

Access to services (for example health, education) and employment opportunities, via the transport infrastructure, would also be relevant aspects of context, according to the theoretical framework presented above. It was hoped that an indicator on transport infrastructure could have be used here, but due to data being incomplete for all regions, the idea to include this indicator had to be dropped.

Housing quality and type, working conditions and environmental pollution were also considered relevant, and an indicator on environmental pollution was investigated, but data were only available at country level. No other data collections within the Eurostat database were available at the required scale and consistency to build an indicator to describe the nature of the wider determinants of health within the study regions.

The conceptual model suggests the socio-economic structure of a place determines how attractive it will be as a residential location and that wealthier migrants, in particular, are more likely to move to more advantaged areas. Net migration was chosen as an indicator of how potentially attractive, or otherwise, a region may be in terms of living and working opportunities it offers. Areas of net inward migration are viewed as more advantaged according to this argument.

Appendix 1 holds some background information around each of the area indicators chosen for the study, covering definitions and methodologies on their calculation.

3.3 Selection of individual characteristics

Individual data have been taken from two longitudinal panel surveys: the *Survey of Health and Aging in Europe* (SHARE) and the *English Longitudinal Study of Aging* (ELSA). The use of the two surveys was required as the UK does not take part in the SHARE. The ELSA survey however is harmonised with the SHARE, so individual data for England can be used alongside data for respondents from other European countries. Both surveys collect micro data on health and socio-economic characteristics on samples of people who are representative of populations aged 50 and over in the countries surveyed. The surveys were chosen as they were the only pan European surveys which have questions on respondents' life histories. For the ELSA survey, this was wave three from 2006/2007 and for the SHARE it was wave three from 2008/2009. The need for life history questions was paramount for the study, if an attempt on investigating the relationship between individual life course histories and socio-economic conditions were to be made. Because these surveys relate to people over 50 years of age , those living in coalfield areas where the mines have now closed may be old enough to have worked in the mining industry while it was still operating, which makes these surveys especially interesting for this research.

3.3.1 Individual health outcomes

Both the SHARE and the ELSA surveys asked questions which covered self-reported physical health of individuals, which were used for the outcome variables for the study:

a. Self-rated general health: In the SHARE respondents were asked: *Would you say your health now is,* and had the following responses to choose from: *'excellent', 'very good', 'good', 'fair'* and *'poor'*. In the ELSA survey respondents were asked: *Would you say your health is,* and had the following responses to choose from: *'very good', 'good', 'fair', 'bad'* and *'very bad'*. Although the SHARE and ELSA surveys are said to be harmonised, there was a significant difference between the two surveys in the coding of the current self-rated general health question responses. In order to produce one set of binary responses for the analysis, the SHARE '*excellent*', '*very good*' and '*good*', and the ELSA '*very good*' and '*good*' responses were classified as '*good health*' and the remainder were classified as '*poor health*'. Further exploration of the data showed that it was going to be difficult and beyond the bounds of this study to assess the statistical effect of grouping the two different survey responses into one classification. As the responses are not precisely comparable, it was decided best practice would be not to attempt to combine them without further statistical assessment, so for analysis of this outcome it was decided to assess the data spilt by the two surveys, the SHARE/Europe regions group and ELSA/England region group.

b. Long-standing illness: The SHARE survey asks respondents '*Do you have any long term health problems, illness, disability or infirmity? Including mental health problems'*. The ELSA survey asks, *'Have you any long-standing illness, disability or infirmity'*. The SHARE question is preceded by the following words '*Some people suffer from chronic or long term health problems. By long term we mean it has troubled you over a period of time or is likely to affect you over a period of time'.* The ELSA question is followed by the words '*By long-standing I mean anything that has troubled you over a period of time, or that is likely to affect you over a period of time'.* The questions were taken as equivalent for the purposes of this study.

Although long-term limiting illness is correlated with perception of general health (Rakowski and Cryan 1990), and the measure of self-rated general health is predictive of morbidity and mortality, (Idler and Benyamini 1997; Riva et al. 2011; OECD 2014), there are potential issues with using self-rated responses to health questions, as responses could vary culturally, and between individuals in the way they perceive how they feel about themselves and how they compare themselves with others within their social and cultural environments. Cross country differences in perceived health status can be difficult to interpret because of these issues. Jylha (1998) suggests that mood, social networks and social comparisons influence the ways in which different health related conditions are expressed in self-rated questions. Mitchell (2005) reports on differences between the way individuals from Wales, England and Scotland report limiting longstanding illness. It is suggested that compared with individuals from England, individuals from Scotland tend to 'under-report' how ill they are, and individuals from Wales are more likely to report their illnesses. These factors need to be taken into account when interpreting the outcomes of the analysis.

3.3.2 Individual demographic, socio-economic and health risk characteristics

Collecting accurate information about people's life history is difficult, so to aid the task the surveys used a special method of gathering this information, called the '*Life History Calendar*', or '*lifegrid*'. This method employs a type of calendar, which shows time across the top and multiple rows down the side, which makes it possible to record different kinds of events in the respondents' lives. As respondents answer questions about key life events, these events are written on the life history calendar. Respondents can then cross-reference certain life-events with others (e.g. '*when I had my first child I was living in house B'*). The calendar also shows important external events, for instance, when JFK was assassinated, which may help respondents recall the timing of personal life events. Using the life history calendar technique has been shown to improve the accuracy of the information people can remember.

The life history questions in the surveys covered a number of topics including: housing and mobility, jobs and earnings, and health. A list of suitable questions which could be used in the study was identified by studying the SHARE life history questionnaire in the first instance. However a comparison with the ELSA survey life history questionnaire found that not all of the SHARE identified questions were asked, and some were not totally comparable; so some useful questions identified in the SHARE questionnaire had to be dropped.

The basis for the selection of the individual characteristic indicators is tied in with the theory of the life course approach of health inequalities, as covered in section 1.3, and the study's conceptual model (figure 1). Individuals through their life course will encounter and deal with events which influence their psycho-social and behavioural processes (C in figure 1). Each individual will react differently depending on their past experience, resilience, mental and physical strengths and weaknesses (D in figure 1), and the social environment they inhabit which shapes social norms (B in figure 1). Psycho-social factors of individual life histories which are known to have a correlation with health outcomes are individual factors like: gender, age, child health, family social status (D in figure 1) and social factors such as: housing, education, employment, unemployment, quality of employment and quality of the natural and human-made environment in which individuals live and work and cultural social norms and social capital (C in figure 1).

Questions from the surveys were selected for potential use within the study to represent each respondent's health, education, employment and social history. Questions were also selected which could potentially give some indication of an individual's health risk behaviour and how economically mobile they may be.

The final set of variables selected to describe individual life history characteristics for the study were:

a. Life course and current health risk characteristics

i. Childhood health status: *'Would you say your health during childhood was in general excellent, very good, good, fair, poor?'*

ii. Current smoking status: *[Do you] smoke now-a-days: Yes/No*

b. Social economic position

Age left education: The variable was manually generated from the survey question: '*In which year did you finish continuous full-time education?*' and the respondent's age at the time of the survey. Ages at which respondents left education were grouped in categories chosen to correspond to the major educational attainment stages in the English educational system: 15 and under (secondary school), 16 to 18 (further education), 19 to 21 (degree), 22 and over (post degree). In the SHARE respondents were able to reply that they had never been to school, so this extra category was included.

This indicator was used as a proxy for social economic position, as the level of education an individual receives helps determine employment, occupation and income chances, important constituents of economic status; but it was hoped that one of the standard classifications could be used to define social economic position of individuals. The SHARE survey offered the use of a derived variable using the International Standard Classification of Occupations (ISCO) classification, but no similar variable was available in the ELSA survey, were social economic status was classified using the National Statistics Socio-economic Classification.

Galobardes et al. (2006 part 1) describes two methods by which education can be measured. Firstly, years of completed education, which assumes that every year of education contributes similarly to an individual's social economic position and that time spent in education holds greater importance than educational achievement. The second method of measurement described takes into account educational milestones, such as level of qualifications achieved, and assumes that these specific achievements are important in determining social economic position. The classification used in this study could be seen as being a hybrid of the two measurements described by Galobardes et al. (2006 part 1). The age groups relate both to years of completed education and to specific stages of educational achievement, in the English data at least. This does highlight an issue however, with using education as an indicator when making comparisons between different countries which have differing educational structures and policies. This is made explicit in the data where the education question asks what year did you finish fulltime education and allows a response that an individual never went to school, in the SHARE there were positive responses to this answer, while in the ELSA survey, there were no individual responses.

Education also has associations with health outcomes, Galobardes et al. (2006 part 1) explains that education can capture both long term influences of early life circumstances on adult health, by reflecting material and intellectual resources, influences of early life course family origin and access to and performance in future schooling; all of which influence adult employment and income chances and adult health outcomes. This suggests that education per se is a useful indicator to include in this study, which has a theoretical link to the life course and incorporates other indicators on health determinants throughout the life course.

c. Economic history

i. Unemployment

This variable was manually generated using the employment history questions. For each job the respondent resigned or was made redundant, they were asked '*Which of these best describes your situation after you left your last job*'. Where respondents replied they were '*Unemployed and searching for a job*', they were assigned a 'Y', as having been unemployed. No differentiation was made between respondents who had been unemployed only once and those who replied they had been unemployed on more than one occasion.

ii. Job industry (if the individual's main job was working in coal mining/quarrying or not)

This variable was manually generated using the employment history questions. For each job recorded, the length of time the respondent had worked in this job was calculated using the start and end dates. The job at which they had worked the longest was then identified and the associated job industry variable connected with that job was extracted. Classification was made on whether the job industry was in *mining and quarrying* or not. Job industry classifications used by the surveys were the International Standard of Occupation Classification by the SHARE and the UK Standard Industrial Classification by the ELSA survey.

Although the two classifications are different each had a unique classification for mining and quarrying.

d. Economically mobile (how long had the individual lived in their current region)
This variable was manually generated from the accommodation history questions. Respondents were asked each time they had moved home when they started living in their new accommodation, the year they moved was also recorded. Each respondent's current region was identified through the last accommodation history question answered, and the date they moved to this accommodation was noted. This date was subtracted from the year 2009 for the SHARE respondents and from 2007 for the ELSA survey respondents, to obtain the number of years each respondent had been living in their current region. The number of years a respondent had lived in their current region was grouped into five categories spanning five years: 5 years and under, 6 to 10 years, 11 to 15 years, 16 to 20 years and 21 years and over.

This indicator is dually used as a measure of how long individuals have been exposed to their current regional environmental conditions.

3.4 Data preparation

The contextual data from the Eurostat regional database and the welfare state classifications from Eikemo et al. (2008) were linked to individual survey records using the individual's current NUTS region of residence, identified from the survey records.

The raw data from both surveys was obtained through self-service online downloads. Once the data had been downloaded, work was then started on each survey file to clean and prepare the data for analysis.

Table 3 shows how the survey question responses were converted into binary or categorical codes.

Table 3: Coding of individual characteristic variables into binary and categorical responses

Variable	Responses	Re-coded Responses
Self-rated health	Good: excellent , very good, good (SHARE) very good, good (ELSA)	0 (reference category)
	Poor: fair, poor (SHARE) fair, bad, very bad (ELSA)	1
Limiting long term illness	No	0 (reference category)
	Yes	1
Gender	Women	0 (reference category)
	Men	1
Age group (years)	50-60	1 (reference category)
	61-70	2
	71-80	3
	81 years and older	4
Marital status	Never married/lived as couple (1)	1 (reference category)
	Once married/lived as couple, now single (2)	2
	Currently married/live as couple (3)	3
Smoke now-a-days	No	0 (reference category)
	Yes	1
Child health status	Good:	0 (reference category)
	Poor:	1
Length of time in current region	5 years and under	1 (reference category)
	6-10 years	2
	11-15 years	3
	16-20 years	4
	21 years and over	5
Age left education	22 and over	1 (reference category)
	19-21	2
	16-18	3
	15 and under	4
	Never went to school	5
Main job industry	Not mining and quarrying	0 (reference category)
	Mining and quarrying	1
Ever unemployed	No	0 (reference category)
	Yes	1

The datasets from the two surveys were combined and records with missing data were deleted to form the final dataset of 15684 individual records. Table 4 shows descriptive statistics for the combined survey sample for each of the individual characteristic variables and regional contextual variables available for use in the study. The majority (84%) of the 1930 cases missing lacked data for variables reporting whether individuals were unemployed, their job industry or their smoking status; another 12% of cases with missing data lacked information on the length of residency in current region and child health status variables. The data were assessed to see if there were any patterns between missing variables and countries, any patterns may suggest variable bias towards certain countries. Across all countries the majority of records that were deleted were due to missing data in the unemployed, job industry and smoking variables (from 96.2% to 72.7%), although for the English and Polish data, no records were deleted due to solely missing smoking data. Spain and Poland had the greater proportion of records deleted because of missing records (Spain: 20.5%, Poland: 19.6%) and the Czech Republic and Germany had the least records deleted (Czech Republic: 2.6%, Germany: 3.5%). All the cases of missing data for length resident in current region were from the English ELSA data.

Table 5 shows the final sample size for each country after data cleaning. Due to the larger sample size from the ELSA survey, the proportion of individuals from England made up 44% of the total data set. Thirty five percent of individuals lived in coalfield regions. Table 6 shows the sample size for each coalfield region.

Analysis of the full data set was based on 15684 individuals living in eighteen coalfield regions and sixty-three non-coalfield regions from seven different countries; Belgium, Czech Republic, England, France, Germany, Poland and Spain.

Table 4: Individual and contextual variable descriptive statistics

		10273 individuals in 63 non-coalfield regions		5411 individuals in 18 coalfield regions	
		n	%	n	%
Individual Health outcomes					
Self-rated health (SHARE)	Good	3881	56.22%	1020	54.08%
	Poor	3022	43.78%	866	45.92%
Self-rated health (ELSA)	Good	2464	73.12%	2363	67.04%
	Poor	906	26.88%	1162	32.96%
Longstanding illness	No	4596	44.74%	2292	42.36%
	Yes	5677	55.26%	3119	57.64%
Individual demographic, health and socio-economic characteristics					
Gender	Women (0)	5531	53.84%	2934	54.22%
	Men (1)	4742	46.16%	2477	45.78%
	Missing	0	0%	0	0%
Age group	50-60 (1)	3618	35.22%	2143	39.60%
	61-70 (2)	3473	33.81%	1655	30.59%
	71-80 (3)	2314	22.53%	1173	21.68%
	81 years and older (4)	868	8.45%	440	8.13%
	Missing	0	0%	0	0%
Marital status	Never married/lived as couple (1)	485	4.72%	217	4.01%
	Once married/lived as couple, now single (2)	2279	22.18%	1376	25.43%
	Currently married/live as couple (3)	7509	73.09%	3818	70.56%
	Missing	0	0%	0	0%
Smoke now a Days	No (0)	8614	83.85%	4512	83.39%
	Yes (1)	1659	16.15%	899	16.61%
	(Missing	81	0.7%	32	0.5%
Child health	Good	9262	90.16%	4835	89.36%
	Poor	1011	9.84%	576	10.64%
	Missing	62	0.56%	26	0.44%
Length of time in current region	5 and under (1)	816	7.94%	500	9.24%
	6-10 (2)	996	9.70%	557	10.29%
	11-15 (3)	950	9.25%	506	9.35%
	16-20 (4)	935	9.10%	615	11.37%
	21 and over (5)	6576	64.01%	3233	59.75%
	Missing	51	0.5%	52	0.9%
Age left Education	22 and over (1)	1061	10.33%	424	7.84%
	19-21 (2)	1556	15.15%	601	11.11%
	16-18 (3)	3874	37.71%	1811	33.47%
	15 and under (4)	3596	35.00%	2530	46.76%
	Never went to school (5)	186	1.86%	45	0.83%
	Missing	25	0.2%	15	0.3%
Job Industry (job worked in longest)	Not mining and quarrying (0)	10147	98.77%	5291	97.78%
	Mining and quarrying (1)	126	1.23%	120	2.22%
	Missing	704	6.3%	422	7.1%
Ever unemployed	No (0)	9401	91.51%	4903	90.61%
	Yes (1)	872	8.49%	508	9.39%
	Missing	450	4.0%	198	3.3%
Regional contextual characteristics		**(mean values)**			
GPD PPS/inhabitant		25214.47		20925.32	
% of population at risk of poverty		16.19%		21.39%	
Net migration		3.03		2.24	
% land use heavy environmental impact		5.30		4.46	

Table 5: Sample size for each country from combined ELSA and SHARE Surveys

Country	Coalfield		Non-coalfield		Total
	n	%	n	%	
Belgium	616	32.10%	1303	67.90%	1919
Czech Republic	203	16.46%	1030	83.54%	1233
France	209	12.27%	1494	87.73%	1703
Germany	254	19.24%	1066	80.76%	1320
Poland	326	22.77%	1106	77.23%	1432
Spain	278	23.52%	904	76.48%	1182
England	3525	51.12%	3370	48.88%	6895
Total	**5411**	**34.50%**	**10273**	**65.50%**	**15684**

Table 6: Sample size for each Coalfield region

Country	Region	Sample size	% of Coalfield region sample
Belgium	Leige] Wallonia Hainaut]	 616	
	Total	**616**	**11.38%**
Czech Republic	Moravskoslezsky (Moravian-Silesian)	203	
	Total	**203**	**3.75%**
France	Nord Pas de Calais	209	
	Total	**209**	**3.87%**
Germany	North Rhine Westphalia Saarland	238 16	
	Total	**254**	**4.69%**
Poland	Dolnoslaskie (Lower Silesia) Slaskie (Silesia) Lubelskie (Lublin)	120 143 63	
	Total	**326**	**6.02%**
Spain	Aragon Principo de Asturias Castile and Leon Castile la Mancha Galicia	41 24 59 89 65	
	Total	**278**	**5.14%**
England	North East (A) North West (B) Yorkshire and the Humber (D) East Midlands (E) West Midlands (F)	442 823 771 745 744	
	Total	**3525**	**65.15%**
European Total		**5411**	

3.5 Statistical methods

The statistical method chosen for the study, in addition to descriptive statistics and cross tabulations, was multivariate logistic regression. Non-weighted counts were used in the data analysis and all analysis was done using STATA, version 10. As the sampling methods of the SHARE and ELSA survey were designed to capture a representative sample of each country's population aged 50 and over in non-institutionalised resident households, differences in age structure of the sample population between countries, and between coalfield and non-coalfield regions, was taken as being representative of the true age structure of the population of each country.

3.5.1 Multivariate logistic regression analysis

The study is interested in understanding the reasons for differences in health outcomes between coalfield and non-coalfield regions. Part of the study hypothesis is that health differences between coalfield and non-coalfield regions can be explained by the differences in the health of individuals who live within the regions. Multivariate regression analysis can be used to build up a model to assess the association between a health outcome variable and a number of other variables chosen as individual health predictors. The regression model will allow the investigation of the independent relationships between the health outcome variables (self-reported health and longstanding illness) and area variables (coalfield and non-coalfield regions), taking into account, or controlling for, individual social, economic and behaviour factors chosen as health determinants. This will allow the identification of how much of a difference in health between coalfield and non-coalfield regions exist after controlling for individual social, economic and behaviour factors. These individual socio-economic and behavioural factor variables are in categorical form.

As the study's health outcome variables are binary in form, that is, an individual reports that they have a longstanding illness or not, or that their self-reported health can be classified as '*poor*' or '*good*'; then the model will be a logistic multivariate regression model, suited for this type of dependent variable. The models predict, respectively, the likelihood of having a long standing illness or having '*poor*' self-reported health.

In addition to the 'main effects' examined in the regression models, interaction effects were explored in the analysis to test whether the associations between outcomes and predictor variables varied for subgroups of the population, classified according to the attributes included in this analysis. The interaction between country and region type was examined because preliminary analysis suggested that there were in fact country differences in the coalfield/non-coalfield relationship with both health outcomes.

Throughout the reporting of results, the convention has been followed that treats as statistically significant associations yielding coefficients with a probability level at or below 5% (indicating with 95% confidence that the association is not a chance occurrence).

STATA has been used for the analysis with beta coefficients chosen to be expressed as odds ratios, which indicate for categorical predicator variables, a percentage of additional risk associated with a particular category, compared with the reference category.

CHAPTER 4

4 Preliminary data investigation

The conceptual framework discussed in chapter two above suggests that the health of populations is likely to show differences between coalfield and non-coalfield regions as a result of complex interactions between the social, economic and cultural health determinants operating over time in coalfield areas, and the psycho-social and behavioural characteristics of individuals who inhabit those places. A preliminary investigation of the data was carried out to test the statistical strength of any observed differences in reported health for individuals in the surveys living in coalfield and non-coalfield regions. This was done using a chi square test on cross tabulated data and bivariate logistic regression analysis.

4.1 Relationship between residence in coalfield or non-coalfield regions and poor self-reported health

Table 7 shows the percentage of individuals reporting their current self-rated heath as '*good*' or '*poor*'. Results are reported for England separately from the other European countries since, as explained above, the measures of reported general health within the two surveys, while similar, were not identical.

Both surveys show a higher proportion of individuals in coalfield regions than non-coalfield regions reporting they have poor health.

The Pearson's chi-square test shows for the ELSA (England) sample that the calculated chi-square statistic (30.33) is significant at the 0.05 probability level, indicating with 95% certainty a statistically significant relationship between the type of region and poor self-reported health, with individuals living in coalfield areas more likely to report poor health.

In contrast, for the SHARE sample (continental European countries), the results show that the calculated chi-square statistic is not significant at the 5% probability level, although it is marginally significant, at the 10% probability level, suggesting an association between current self-rated heath and region type across the countries of continental Europe that is statistically weaker than in the UK, although in the SHARE sample, those in coalfield areas again show a slightly higher proportion with poor health.

Table 7: Individual self-reported health

Health Outcome	Survey	Reported outcome	Coalfield regions	Non-coalfield regions	Total	Pearson Chi^2
Self-Reported Health	ELSA	% reporting good health	67.04	73.12	70.01	30.33 (1df) p=0.000
		% reporting poor health	32.96	26.88	29.99	
	SHARE	% reporting good health	54.08	56.22	55.76	2.75 (1df) p=0.097
		% reporting poor health	45.92	43.78	44.24	

SHARE survey: Belgium, Czech Republic, France, Germany, Poland, Spain
ELSA survey: England

These findings were confirmed using a bivariate logistic regression analysis to assess the strength of the relationships between living in a coalfield region and reporting poor health without controlling for other possible individual and contextual determinants of poor health.

For the ELSA English survey respondents, living in a coalfield region was associated with a significantly greater likelihood of reporting poor health (OR: 1.34; 95%CI: 1.21-1.48, p=0.000), showing that the odds of reporting poor health is 34% higher given residence in a coalfield region compared to living in an non-coalfield region. The SHARE European data, showed that living in a coalfield region was associated with a slightly greater likelihood of reporting poor health (OR: 1.09; 95%CI: 0.98-1.21, p=0.097). Although this is not statistically significant at the $\alpha = 0.05$, 5% level, the relationship is just significant at the $\alpha = 0.10$, 10% level, suggesting a weak trend towards greater chance of reporting poor health in coalfield areas across the European sample as a whole.

A further regression analysis was done to assess the association between coalfield region and poor health typically controlling for age and sex. For both the ELSA English (OR: 1.36; 95%CI: 1.22-1.51, p=0.000) and SHARE European (OR: 1.11; 95%CI: 1.00-1.23, p=0.050), the results show that the coalfield effect holds and is strengthened through these demographic variables.

4.2 Relationship between residence in coalfield and non-coalfield regions and reporting a longstanding illness

Table 8 shows that, comparing those in coalfield and non-coalfield regions, a higher proportion of individuals in coalfield regions than non-coalfield regions report they have a longstanding illness.

The Pearson's chi-square test shows that the calculated chi-square (8.15) is statistically significant at the 5% level. This shows we can be more than 95% certain that the association between reporting a longstanding illness and region type is not due to chance and there is a significant relationship between type of region and the reporting of longstanding illness, such that, on average, those in coalfield regions are more likely to report a long standing illness.

Table 8: Individuals reporting longstanding illness

Health Outcome	Reported outcome	Coalfield regions	Non-coalfield regions	Total	Pearson Chi^2
Longstanding illness	% reporting no longstanding illness	42.36	44.74	43.92	8.15 (1df) p=0.004
	% reporting longstanding illness	57.64	55.26	56.08	

Further analysis using bivariate logistic regression show that, without controlling for individuals' demographic, social and economic characteristics, living in a coalfield region was associated with a significantly greater likelihood of reporting a long standing illness (OR: 1.10; 95%CI: 1.03-1.18,p=0.004), suggesting that the odds of having a longstanding illness is 10% higher given residence in a coalfield region compared to living in a non-coalfield region.

A further regression analysis was done to assess the association between coalfield region and longstanding illness controlling for age and sex. The results show that the coalfield effect holds and is strengthened through these demographic variables (OR: 1.34; 95%CI: 1.22-1.47, p=0.000).

4.3 Conclusion: preliminary evidence of a 'coalfield effect' associated with self-reported health and long term illness

To summarise the results of the Chi square tests on cross tabulations and bivariate regression, analyses suggest that for long term illness and, to some extent for self-reported health, there are relationships between type of region and health outcomes for the England and continental European samples, with those living in coalfield areas more likely to report worse health outcomes. With respect to self-reported health, the result from the England sample is statistically significant at the 5% level, while for the European sample, the result is just statistically significant at the 10% level. For long-standing illness, results for the whole sample show that there is a statistically significant relationship between type of region and reporting longstanding illness at the 5% level, with those living in coalfield areas more likely to report they have a longstanding illness.

The findings from this initial data investigation suggested that it was appropriate to analyse the data further to explore the hypothesised interactions between the social and economic characteristics of places and the psycho-social and behavioural characteristics of individuals, as suggested through the conceptual framework presented above. These analyses are presented in chapters six and seven below.

CHAPTER 5

5 Exploring variations in health outcomes by country and region type

The conceptual model introduced in chapter two above suggests that national as well as regional context may be important for health. This stage of the analysis explores whether there are variations in health associated with area differences among countries and among regions within countries, particularly area differences distinguishing coalfield and non-coalfield areas.

If country of residence proves to be a factor associated with the health outcomes of interest, this would need to be taken into account when carrying out the more detailed analytical models, presented in chapter six below.

5.1 Self-reported health: variation by country of residence

Table 9 shows significant differences by country in the proportions reporting poor health vs. good health across the SHARE sample. Results from running a chi square test showed that Belgium has lower proportions of individuals reporting poor self-reported health with Poland and Spain have higher proportions of individuals reporting poor self-reported health. The ELSA data from England are not strictly comparable (as explained in chapter three).

Table 9: Reporting of general health across countries

Country	Belgium	France	Czech Rep	Spain	Germany	Poland	Total	England
% Reporting good health	69.98	61.66	56.61	47.88	56.89	34.43	55.76	70.01
% Reporting poor health	30.02	38.34	43.39	52.12	43.11	65.57	44.24	29.99
Pearson Chi square	Chi^2 476.35 (5df) p=0.000							

5.2 Longstanding illness: variation by country of residence

Table 10 shows combined data for SHARE and ELSA respondents. Given the older age group represented in this sample, long standing illnesses are quite common and in all countries, apart from Belgium, the majority of respondents report some long term illness. There are significant differences by country in the proportions reporting that they have a longstanding illness. Belgium has a relatively smaller proportion of individuals reporting a longstanding illness and Germany and Poland have relatively large proportions with longstanding illness.

Table 10: Reporting of longstanding illness across countries

Country	Belgium	England	France	Czech Rep	Spain	Germany	Poland	Total
% Not reporting longstanding illness	51.22	46.38	45.80	42.25	41.79	34.24	32.12	43.92
% Reporting longstanding illness	48.78	53.62	54.20	57.75	58.21	65.76	67.88	56.08
Pearson Chi square	Chi^2 195.65 (6df) p=0.000							

5.3 Country variation in health differences between coalfield and other regions

Given that there seemed to be variability by country in reporting of the health outcomes, the next preliminary stage of the analysis explored whether relationships between health outcome and living in a coalfield region also varied by country.

5.3.1 Country variation in self-reported health

Table 11 and figure 2 show data from the SHARE survey comparing the proportions reporting poor health by region type by country in continental Europe. For samples from both coalfield and non-coalfield regions in Europe, there were significant differences across countries in self-reported health. In both coalfield and non-coalfield regions Poland (coalfield 62%, non-coalfield 67%) and Spain (coalfield 55%, non-coalfield 51%) had the highest percentage of individuals reporting poor health, with Belgium having the least (coalfield 35%, non-coalfield 28%). In the coalfield regions of France, Spain and Poland, individuals were more likely to report poor health than good health. In the non-coalfield regions individuals were more likely to report poor health than good health in Spain and Poland.

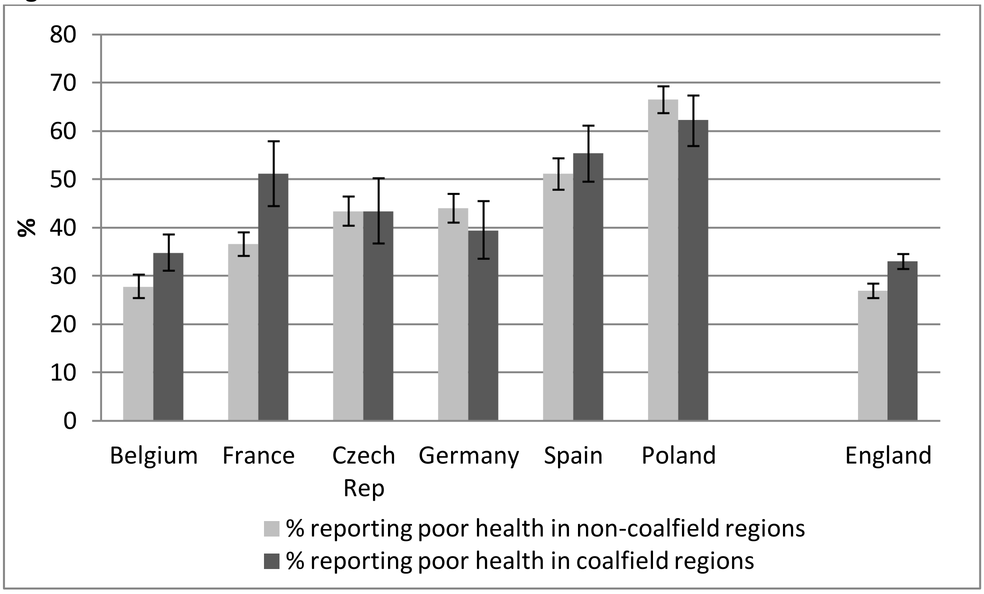
In English coalfield regions 33% of individuals reported they had poor health and 27% of individuals in non-coalfield regions reported they had poor health. The data for England from the ELSA survey is not strictly comparable, but shows a larger proportion reporting poor health in coalfield regions than non-coalfield regions.

Table 11: Cross country variation in self-reported health in coalfield and non-coalfield regions

Region Type	Country	Belgium	France	Czech Rep	Spain	Germany	Poland	Total	England
Coalfield regions	% Reporting good health	65.26	48.80	56.65	44.60	60.63	37.73	54.08	67.04
	% Reporting poor health	34.74	51.20	43.35	55.40	39.37	62.27	45.92	32.96
Pearson Chi square test		Chi^2 419.95 (5df) p=0.000							
Non-coalfield regions	% Reporting good health	72.22	63.45	56.60	48.89	56.00	33.45	56.22	73.12
	% Reporting poor health	27.78	36.55	43.40	51.11	44.00	66.55	43.78	26.88
Pearson Chi square test		Chi^2 83.42 (5df) p=0.000							

The interesting point to note from this analysis is that for all countries except Germany, Poland and the Czech Republic, higher proportions of respondents in coalfield regions than in non-coalfield regions report that they have poor health, as illustrated in figure 2; the underlying patterns associated with this finding are also interesting. An apparent 'protective' coalfield effect seems to operate in Poland and Germany where those in coalfield areas are less likely to report poor health than those in non-coalfield areas. In Poland poor health is more common than good health in both coalfield and non-coalfield regions, but in Germany, as with most of the other countries, poor health is less common than good health in both coalfield and non-coalfield regions (table 11). In the Czech Republic there is little difference between coalfield and non-coalfield areas in reporting of poor health.

Figure 2: Cross country variation in reporting general health by coalfield and non-coalfield region



Error bars showing 5% confidence intervals

5.3.2 Country variation in reporting longstanding illness

Table 12 shows by region type and by country the proportions of individuals reporting having a longstanding illness or not. The interesting point to note from this analysis is that all countries have higher proportions of respondents in coalfield regions than non-coalfield regions reporting they have a longstanding illness, except Poland and Germany where the reverse is true.

For both coalfield and non-coalfield regions, there were significant differences across countries in the reporting of longstanding illness. In both coalfield and non-coalfield regions Poland (coalfield 63%, non-coalfield 70%) and Germany (coalfield 64%, non-coalfield 66%) have amongst the highest percentage of individuals reporting they had a longstanding illness, with Belgium having the least (coalfield 51%, non-coalfield 48%).

Across all countries apart from Belgium and England, in both coalfield and non-coalfield regions, individuals were more likely to report they had a longstanding illness than not. In Belgium individuals in non-coalfield regions were more likely to report they had no longstanding illness.

Table 12: Cross country variation in reporting longstanding illness by region type

Region Type	Country	Belgium	England	France	Czech Rep	Spain	Germany	Poland	Total
Coalfield regions	% Not reporting longstanding illness	48.86	43.01	40.19	36.45	37.77	36.22	36.81	42.36
	% Reporting longstanding illness	51.14	59.99	59.81	63.55	62.23	63.78	63.19	57.64
Pearson Chi square test		Chi 25.01 (6df) p=0.000							
Non-coalfield regions	% Not reporting longstanding illness	52.34	49.91	46.59	43.40	43.03	33.77	30.74	44.74
	% Reporting longstanding illness	47.66	50.10	53.41	56.60	56.97	66.23	69.26	55.26
Pearson Chi square test		Chi 210.32 (6df) p=0.000							

To confirm these findings a series of simple logistic regression analyses were carried out, stratified by country, to assess the strength of the relationships between living in a coalfield region and reporting poor health or a longstanding illness. Table 13 shows for self-reported health that there are statistically significant ‘coalfield effects’ for England, Belgium and France; with individuals in coalfield regions in each of these countries being more likely to report poor health than individuals in non-coalfield regions. For longstanding illness, individuals living in English coalfield regions were significantly more likely to report having a longstanding illness than individuals living in non-coalfield regions. While for Poland, in contrast, there is a statistically significant ‘protective’ effect from living in a coalfield region. In most other countries (except Germany) there is a statistically insignificant tendency towards greater risk of longstanding illness in coalfield regions.

Table 13: Odds ratios for health outcomes in coalfield regions (compared with non-coalfield regions) stratified analyses with separate models for each country

Country	Coalfield Region Odds ratios	
	Self-reported health	Longstanding illness
England	1.337*** (1.206-1.483)	1.320*** (1.201-1.452)
Belgium	1.384** (1.127-1.699)	1.149 (0.949-1.392)
Czech Republic	0.998 (0.737-1.352)	1.337 (0.979-1.825)
France	1.821*** (1.362-2.436)	1.298 (0.967-1.743)
Germany	0.827 (0.625-1.093)	0.898 (0.675-1.195)
Poland	0.830 (0.642-1.072)	0.762* (0.588-0.987)
Spain	1.188 (0.907-1.557)	1.245 (0.944-1.640)

significance level: ***p<=0.001, **p<=0.01, *p<=0.05

5.4 The interaction between country and coalfield region for health outcomes

The analysis above was extended to show in more detail the interaction between country and coalfield region, showing the country differences in the association between coalfield region and health outcome.

Figures 3 and 4 give a visual representation of the interaction between country and coalfield region on poor health and longstanding illness respectively. The figures show regression lines of the predicted probabilities of poor health or longstanding illness, against region type. They further illustrate the differing relationships between health outcomes between coalfield and non-coalfield regions in Germany and Poland and to a lesser extent in the case of poor health for the Czech Republic, compared to the other countries represented. These three countries showed lower proportions of individuals in coalfield regions reporting they have poor current heath or a longstanding illness, than in non-coalfield regions, whereas the reverse was true in most other countries.

Figure 3: Predicted probabilities for poor heath by country using interaction term

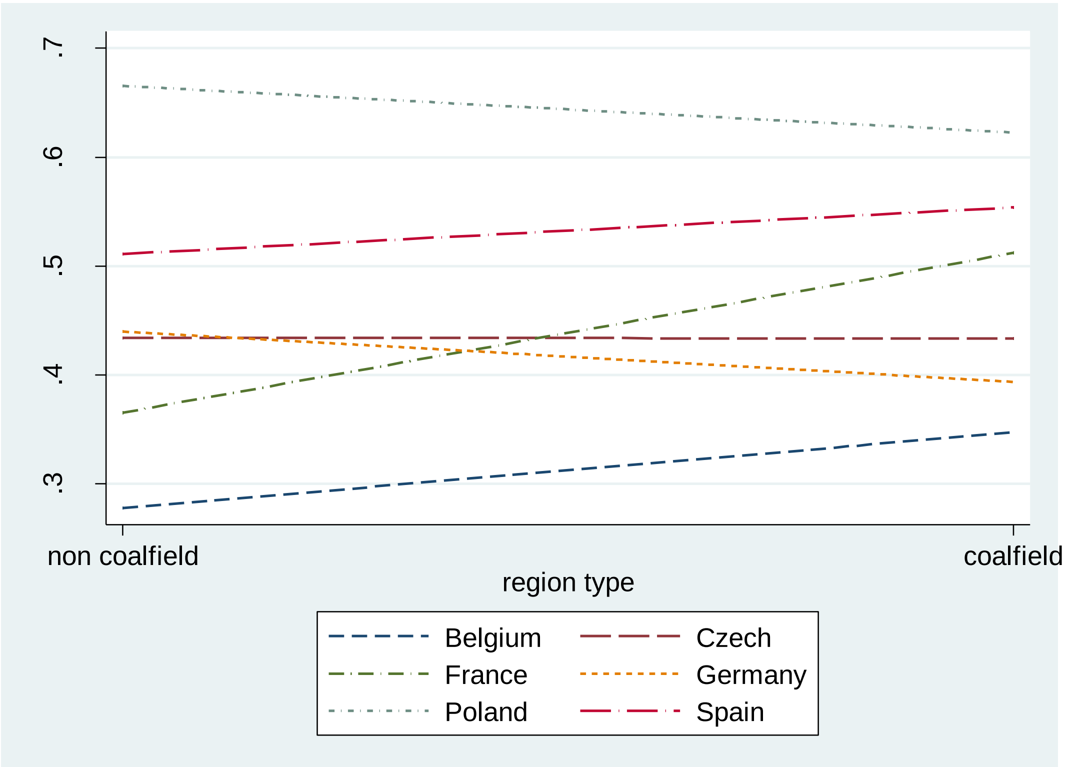
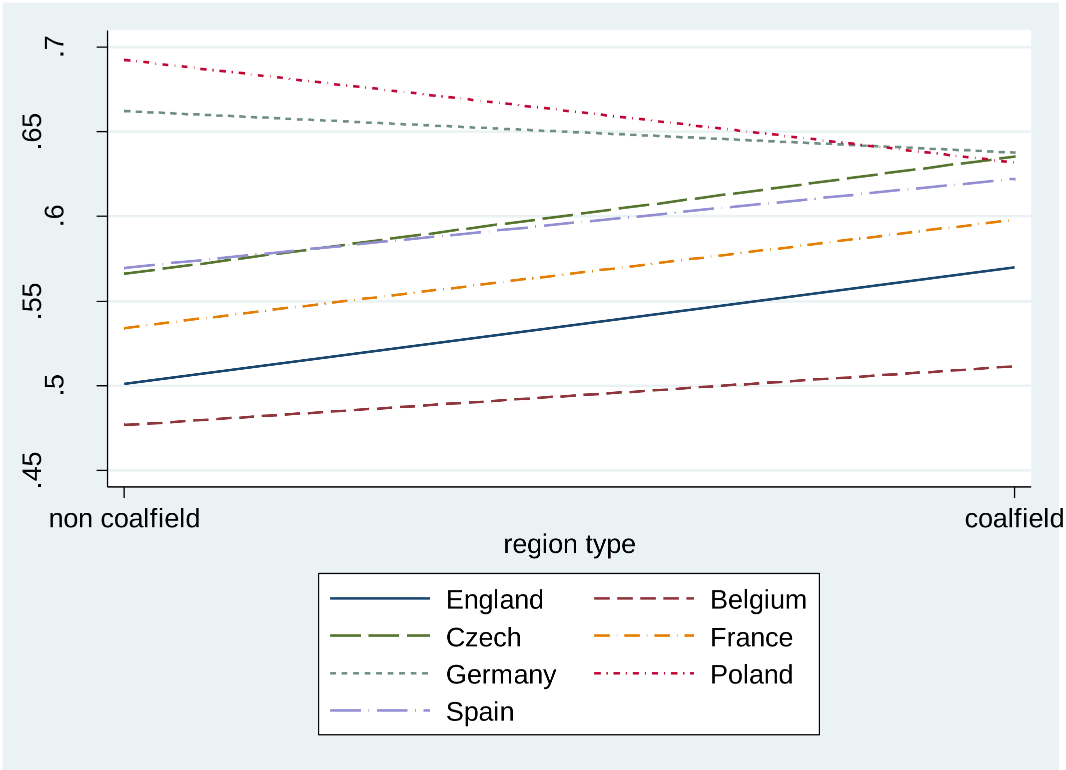


Figure 4: Predicted probabilities for longstanding illness by country using interaction term



5.5 Exploring the variation in health outcomes by country

Prior to running the full multivariate regression analysis, the interaction term for country and coalfield of residence was assessed without adjusting for any other predictor variables to explore the relationship of coalfield area residence and heath outcome.

The results in table 14 for current health show that compared to individuals in Belgium, individuals in all other countries were more likely to report they had poor health. After controlling for a general tendency for those in coalfield areas to report poor health more than in other areas, and allowing for country differences, the result suggests that compared to individuals in Belgian coalfield regions, individuals in German and Polish coalfield regions were significantly less likely to report poor health. The results for the Czech Republic also showed individuals were less likely to report poor health but the result was non-significant.

Table 14: Odds ratios for country/current coalfield region interaction for current health (without adjusting for other predictor variables)

Interaction variable		**Odds Ratio (95% CI)**
Type of region	Non-coalfield	1.00
	Coalfield	1.384** (1.127-1.699)
Country	Belgium	1.00
	Czech Rep	1.993***(1.677-2.369)
	France	1.500 ***(1.275-1.758)
	Germany	2.042 ***(1.721-2.424)
	Poland	5.171 ***(4.345-6.154)
	Spain	2.717***(2.274-3.247)
Coalfield region/country interaction term	Belgium/current region coalfield	1.00
	Czech Republic/current region coalfield	0.721 (0.500-1.041)
	France/current region coalfield	1.316 (0.922-1.879)
	Germany/current region coalfield	0.597**(0.422-0.845)
	Poland/current region coalfield	0.600** (0.432-0.833)
	Spain/current region coalfield	0.859 (0.612-1.206)

significance level: ***p<=0.001, **p<=0.01, *p<=0.05

The results in table 15 for longstanding illness show that compared to individuals in England, individuals in all other countries apart from Belgium were more likely to report a longstanding illness. After controlling for a general tendency for those in coalfield areas to report a longstanding illness more than in other areas, and allowing for country differences, compared to individuals in English coalfield regions, individuals in Germany and Poland coalfield regions were significantly less likely to report a longstanding illness.

Table 15: Odds ratios for country/current coalfield region interaction for longstanding illness (without adjusting for other predictor variables)

Interaction variable		**Odds Ratio (95% CI)**
Coalfield region	No	1.00
	Yes	1.320*** (1.201-1.452)
Country	England	1.00
	Belgium	0.907 (0.798-1.031)
	Czech Rep	1.300***(1.129-1.496)
	France	1.142 *(1.011-1.291)
	Germany	1.954 ***(1.692-2.256)
	Poland	2.245 ***(1.943-2.594)
	Spain	1.319***(1.138-1.530)
Coalfield region/country	England/current region coalfield	1.00
	Belgium/current region coalfield	0.870 (0.7027-1.078)
	Czech Republic/current region coalfield	1.012 (0.731-1.401)
	France/current region coalfield	0.983 (0.721-1.339)
	Germany/current region coalfield	0.680* (0.503-0.919)
	Poland/current region coalfield	0.578 ***(0.438-0.761)
	Spain/current region coalfield	0.942 (0.704-1.262)

significance level: ***p<=0.001, **p<=0.01, *p<=0.05

5.6 Cultural differences in responding to health survey questions

It is possible that some cross country differences in health could be related to cross country differences in the way individuals respond to survey questions on self-reported health status. However, as reported in the literature (Mitchell 2005; Jylha 1998; Elstad 1996), it is not entirely clear how far this may be the case. As such a brief assessment of the study data was made in order to ascertain if there were any apparent relationships between country and region type and reporting a longstanding illness, or poor health, which should be taken into account when interpreting results.

In order to do this, the relationship between life expectancy at 50 years and the percent of individuals reporting poor health or longstanding illness was assessed. Data for England is not collected by Eurostat, so the life expectancy for the UK as a whole (England, Scotland, Wales and Northern Ireland) is used as a proxy for the life expectancy for England. The results show that there is a weak relationship between life expectancy at 50 years and the proportion of individuals in the SHARE and ELSA survey reporting poor health ($r^2 = 0.3$) and a having a long standing illness ($r^2 = 0.3$)at country level.

Figures 5 and 6 show that France has the highest life expectancy at 50 years of age. If it is assumed that populations with longer life expectancy will report in general better health outcomes, one might expect that populations in Belgium and the UK (proxy for England) would be more likely to report poor heath and a longstanding illness than populations in France, but this is not the case.

Germany has a similar life expectancy to Belgium and UK, but proportionally more individuals in Germany report they have poor health and a longstanding illness. This may indicate that individuals in Germany are more likely to report they have poor health outcomes than individuals in Belgium and the UK.

Individuals living in Poland and the Czech Republic have distinctly lower life expectancies than individuals from all the other study countries, but the data suggests that individuals from the Czech Republic are less likely to report they have poor heath, and individuals from the Czech Republic and Poland are less likely to report they have a longstanding illness.

However a counter argument could be that although individuals in France and Spain have longer life expectancies, they may not be living longer in good health.

Figure 5: Relationship between life expectancy at 50 years (2007) and likelihood of reporting poor health by country

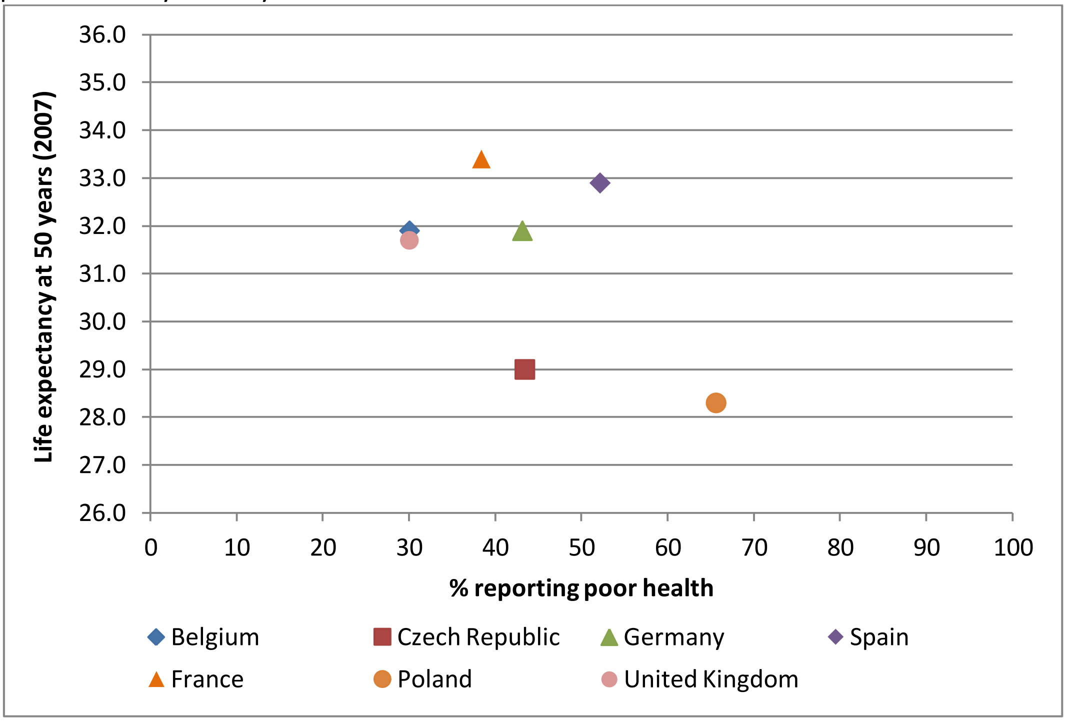
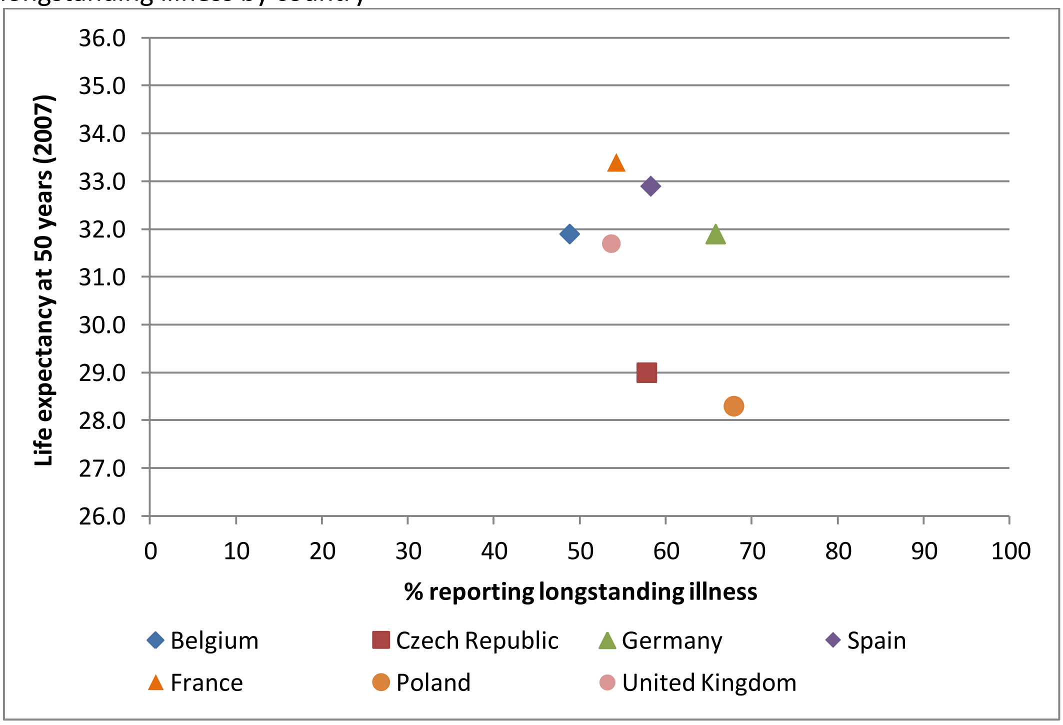


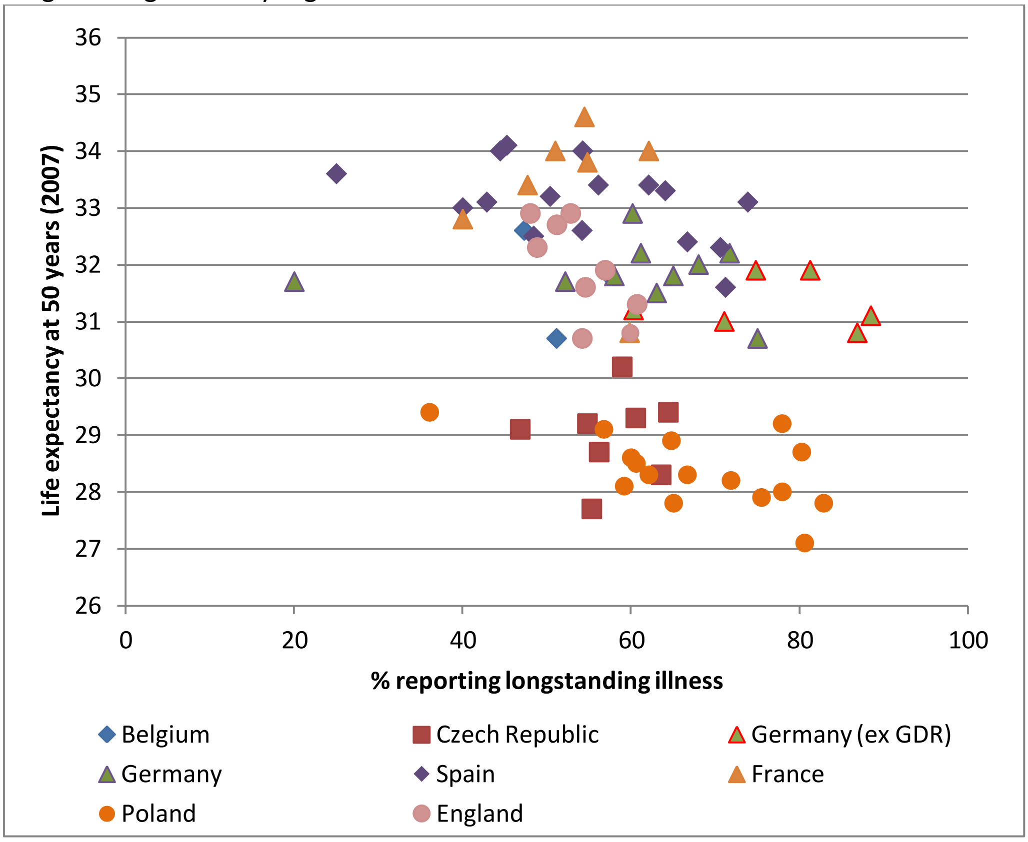
Figure 6: Relationship between life expectancy at 50 years (2007) and likelihood of reporting longstanding illness by country



Data source: Eurostat, Regional demographic statistics

Figure 7 looks deeper into the data, investigating further patterns of reporting longstanding illness and life expectancy at regional level within each country. It is seen that there is quite a large amount of variability across each country's regions in the reporting of longstanding illness along lines of similar life expectancy, for example Poland: 59% to 83% reporting a longstanding illness around life expectancy of 28 years; Spain 40% to 74% reporting a longstanding illness around life expectancy of 33 years and Germany 61% to 88% reporting a longstanding illness around life expectancy of 31 years. The regions of England however, show a more clustered pattern with a moderate negative association between life expectancy at 50 years and reporting a longstanding illness.

Figure 7: Relationship between life expectancy at 50 years (2007) and likelihood of reporting longstanding illness by region



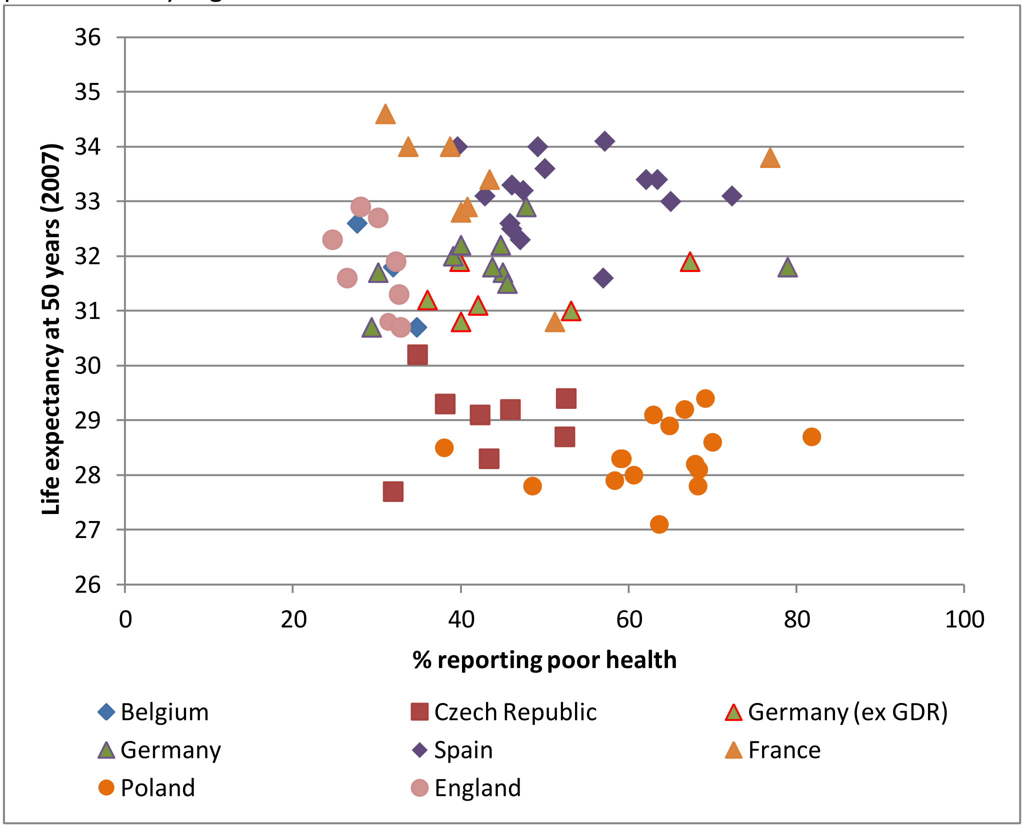
So the survey data used in this research shows there is variation within countries in how individuals from different regions report longstanding illness, which is not related to life expectancy. For England the data shows that there could be no regional cultural influence in reporting of longstanding illness. However, for the larger countries like France and Poland, and countries with federal histories like Germany and Spain, there are more opportunities to develop cultural differences between regional populations, than in smaller countries like England. This could be the reason for the high regional variations in reporting longstanding illness in these countries identified in the data. It is noted that the majority of the German regions reporting higher proportions of longstanding illness around life expectancy of 31 years and 32 years, are regions from the ex-German Democratic Republic, this could point to cultural differences between individuals in reporting longstanding illness between East and West

Germany; with individuals from the old Eastern Germany regions being more likely to report longstanding illness than their Western compatriots. However, this pattern could also illustrate another picture, which would indicate there are not necessarily cultural differences in reporting longstanding illness, but there are differences in how healthy individuals are living at the respective levels of life expectancy between the two old states. Although having similar life expectancies to their compatriots in the west, individuals in the east could be living with more ill health due to the legacy of the old political regime. This could also explain apparent cross country differences in the reporting of longstanding illness between some regions of France and Spain and the Czech Republic and Poland, in that individuals in France and Spain are living longer but they are doing so in poorer health, thus counteracting any apparent cross country differences in reporting longstanding illness.

Figure 8 looks further into the patterns of reporting poor health and life expectancy at regional level within each country. Here too there is quite a large amount of variability across the regions of Poland, Spain, Germany and France in reporting poor health along lines of similar life expectancy; and again, a more clustered pattern is seen for the England regions.

Figure 8 could also suggest the argument for individuals in France, Spain and western Germany living longer, but are doing so in poorer health (assuming cultural differences are held constant) is not necessarily holding true, so counter acting any apparent cross country or between region differences in reporting longstanding illness. So possibly suggesting the variation in reporting longstanding illness and poor heath does have a degree of cultural influence.

Figure 8: Relationship between life expectancy at 50 years (2007) and likelihood of reporting poor health by region



CHAPTER 6

6 Investigating how far individual factors may explain health in coalfield regions

The next stage of the main data analysis was to explore further how far the data supported the conceptual framework laid out in chapter two, by introducing into the analyses a number of individual variables that might affect health outcomes. According to the literature reviewed above, some of the variation in health between coalfield and other regions might be accounted for by the composition of the population in these regions and their individual attributes.

The analysis explored whether the health differences between groups of individuals in coalfield and non-coalfield areas may be the same or different across countries within Europe, and explored how far area differences may be associated with demographic, socio-economic and health risk characteristics of the individuals living in these different areas.

The first step involved carrying out a set of bivariate analysis to investigate the associations between the health outcome variables and each of the individual level predictor variables measuring demographic, socio-economic and health risk determinants of health.

A second phase of analysis involved the use of multivariate logistic regression analysis to assess the combined impact of individual demographic, health and socio-economic characteristics on health and to see if individual characteristics could account for the 'coalfield effect' on health outcomes.

6.1.1 Bivariate analysis of self-reported health and individual predictor variables by country

The results of the bivariate analysis of individual level predictor variables on poor self-reported health presented in table 16, show that across all countries there were similar associations between self-reported health and some individual level predictor variables, though the levels of significance varied. Older age groups were more likely to report poor health compared to younger individuals, the risk of reporting poor health was greater for individuals who left education at younger ages (assumed lower socio-economic position) and individuals who had poor health as a child were more likely to report poor health as older adults. There were no significant differences between the length of time individuals had resided in their current region (economically mobile) and the likelihood of reporting poor health. In Belgium and Spain, men were significantly less likely to report poor health than women.

Individuals in England, Belgium and Germany who were married or were co-habiting, were significantly less likely to report poor health than individuals who had never married; while in France and Spain individuals who were widowed or divorced were more likely to report poor health than individuals who had never married. The patterns identified here could reflect the fact that perhaps in France and Spain, the greater likelihood of reporting poor health was more likely due to individuals being widowed than divorced, reflecting the fact that older individuals are more likely to be widowed and more likely to report poor health. The patterns in England, Germany and Belgium reflects the common held opinion that social support and companionship is a health protective factor.

In England and Belgium individuals who currently smoked were more likely to report poor health than individuals who did not smoke; while the results for Poland and Spain suggested that individuals who smoked were less likely to report poor health. Individuals in England who had worked in mining or quarrying were more likely to report poor health than individuals who had not worked in mining or quarrying. Individuals in Poland who had been unemployed were less likely to report poor health than those who had not been unemployed.

Table 16: Results of bivariate logistic regression analysis of individual demographic, social and economic characteristics and poor self-reported health: Individual Country

Variable		**England**	**Belgium**	**Czech Republic**	**France**
		Odds Ratio (95% CI)	**Odds Ratio (95% CI)**	**Odds Ratio (95% CI)**	**Odds Ratio (95% CI)**
Gender	Women	1.00	1.00	1.00	1.00
	Men	0.983(0.886-1.090)	0.760 ** (0.624-0.925)	0.960 (0.764-1.206)	0.952 (0.782-1.159)
Age group	50-60	1.00	1.00	1.00	1.00
	61-70	1.390*** (1.220-1.581)	1.258 (0.982-1.612)	1.164 (0.887-1.526)	1.211 (0.941-1.560)
	71-80	1.932*** (1.685-2.215)	1.473** (1.126-1.925)	2.223*** (1.600-3.089)	2.706*** (2.064-3.548)
	81+	2.579*** (2.145-3.101)	3.008*** (2.135-4.237)	4.227*** (2.437-7.332)	5.933*** (4.074-8.643)
Marital status	Never married/cohabited	1.00	1.00	1.00	1.00
	Married/cohabited but not currently	1.049 (0.811-1.357)	0.843 (0.524-1.357)	1.069 (0.499-2.291)	2.276 ***(1.517-3.415)
	Married/cohabited still	0.555*** (0.433-0.710)	0.586* (0.372-0.923)	0.614 (0.296-1.287)	1.203 (0.820-1.765)
Age left education	22 years +	1.00	1.00	1.00	1.00
	19-21	1.527* (1.072-2.175)	1.023 (0.716-1.462)	1.608* (1.013-2.554)	1.485* (1.022-2.158)
	16-18	2.028*** (1.520-2.706)	1.357 (0.976-1.887)	1.966** (1.294-2.989)	2.199*** (1.571-3.076)
	15 and under	4.281 *** (3.228-5.677)	1.948*** (1.392-2.725)	2.389*** 1.485-3.843)	4.118*** (2.931-5.785)
	Never went to school	- - -	8.559** (2.203-33.254)	- - -	5.632*** (2.321-13.666
Child Health Status	Good	1.00	1.00	1.00	1.00
	Poor	2.364*** (2.034-2.747)	2.764*** (1.962-3.895)	4.282*** (2.547-7.199)	2.215*** (1.624-3.019)
Current smoker	No	1.00	1.00	1.00	1.00
	Yes	1.846*** (1.609-2.119)	1.312* (1.012-1.700)	0.907 (0.688-1.194)	1.081 (0.823-1.420)
Length in current region	<5 years	1.00	1.00	1.00	1.00
	6-10	1.131 (0.885-1.190)	1.593 (0.981-2.589)	1.391 (0.620-3.121)	0.969 (0.611-1.538)
	11-15	0.962(0.804-1.084)	1.227 (0.756-1.992)	1.153 (0.551-2.411)	1.025 (0.647-1.622)
	16-20	0.929 (0.810-1.088)	0.942 (0.564-1.576)	1.181 (0.573-2.434)	1.056 (0.673-1.657)
	21 and over	1.188* (1.004-1.406)	0.908 (0.625-1.319)	1.168 (0.664-2.055)	1.079 (0.749-1.554)
Job industry	Not worked in mining/quarrying	1.00	1.00	1.00	1.00
	Worked in mining/quarrying	2.794*** (1.670-4.675)	1.077 (0.407-2.847)	1.026 (0.462-2.278)	1.181 (0.712-1.959)
Unemployed ever	No	1.00	1.00	1.00	1.00
	Yes	1.074 (0.910-1.268)	1.307 (0.917-1.874)	1.499 (0.845-2.658)	0.830 (0.586-1.175)

significance level: ***p<=0.001, **p<=0.01, *p<=0.05

Table 16: Results of bivariate logistic regression analysis of individual demographic, social and economic characteristics and poor self-reported health: Individual country

Variable		Germany	Poland	Spain
		Odds Ratio (95% CI)	Odds Ratio (95% CI)	Odds Ratio (95% CI)
Gender	Women	1.00	1.00	1.00
	Men	1.001 (0.805-1.246)	1.027 (0.825-1.279)	0.629 *** (0.499-0.793)
Age group	50-60	1.00	1.00	1.00
	61-70	1.180 (0.905-1.538)	1.894 *** (1.473-2.433)	1.563** (1.158-2.109)
	71-80	1.580** (1.171-2.131)	3.778*** (2.681-5.322)	2.553*** (1.875-3.477)
	81+	4.056*** (2.419-6.800)	5.015*** (2.721-9.242)	2.609*** (1.715-3.970)
Marital status	Never married/cohabited	1.00	1.00	1.00
	Married/cohabited but not currently	0.836 (0.451-1.547)	1.605 (0.778-3.311)	2.238** (1.295-3.868)
	Married/cohabited still	0.538* (0.304-0.953)	1.211 (0.609-2.408)	1.413 (0.896-2.228)
Age left education	22 years +	1.00	1.00	1.00
	19-21	2.051*** (1.427-2.949)	1.596 (0.931-2.734)	1.478 (0.653-3.346)
	16-18	2.100*** (1.520-2.909)	2.302** (1.375-3.853)	1.383 (0.750-2.550)
	15 and under	3.751*** (2.566-5.484)	3.903*** (2.322-6.562)	2.189** (1.271-3.770)
	Never went to school	- - -	9.172* (1.068-78.768)	4.517 *** (2.459-8.299)
Child Health Status	Good	1.00	1.00	1.00
	Poor	1.956*** (1.403-2.726)	2.387 ** (1.431-3.981)	2.893 *** (1.900-4.404)
Current smoker	No	1.00	1.00	1.00
	Yes	1.293 (0.966-1.729)	0.745 * (0.578-0.959)	0.627**(0.456-0.863)
Length in current region	<5 years	1.00	1.00	1.00
	6-10	0.701 (0.385-1.278)	0.973 (0.410-2.308)	1.024 (0.513-2.041)
	11-15	0.668 (0.368-1.211)	0.907 (0.387-2.123)	0.915 (0.462-1.811)
	16-20	0.603 (0.320-1.138)	0.764 (0.345-1.689)	0.957 (0.485-1.890)
	21 and over	0.811 (0.497-1.324)	1.106 (0.569-2.121)	1.136 (0.649-1.989)
Job industry	Not worked in mining/quarrying	1.00	1.00	1.00
	Worked in mining/quarrying	1.590 (0.483-5.236)	0.988 (0.543-1.797)	0.824 (0.333-2.044)
Unemployed ever	No	1.00	1.00	1.00
	Yes	1.047 (0.732-1.497)	0.522** (0.357-0.764)	1.264 (0.744-2.147)

significance level: ***p<=0.001, **p<=0.01, *p<=0.05

6.1.2 Bivariate analysis of self-reported health and individual predictor variables for continental Europe

The results of the analysis of individual demographic, socio-economic and health risk characteristics and self-reported health, using SHARE data for all the continental European countries combined, are reported in table 17.

These results show that men were less likely to report they had poor health than women. As expected, older age groups were more likely to report poor health when compared to younger individuals (50-60); for individuals who were 61-70 years risk of reporting poor health was more than 30% greater; individuals who were 71-80 years were twice as likely, and individuals who were 81+ years where over three times more likely, to report poor health.

The risk of reporting poor health was greatest in individuals who had left school under 21 years of age. Compared to those who had left education aged over 21 years old, the risk of reporting poor health was over three times greater for individuals who had left education aged 15 and under, and over six times greater for those who never went to school. So taking age left education as a proxy for social classification, the results indicate that individuals in lower social classes had greater risk of poor health than those in higher social classes.

Individuals who had been separated, divorced or widowed were significantly more likely to report poor health than those who had never been married or never had a partner. Those who reported poor health as a child were over twice as likely to report they had poor health in their older years, compared with those who reported good health as children.

Those who had lived in their current region 21 years and over were 21% more likely to report they had poor health than individuals who had lived less than 5 years in their current region. This result is probably influenced by the fact that these are more likely to be the older individuals in the study, rather than being other influences brought on by living for an extended period in the same region or being less economically mobile, as investigation of the data showed that the vast majority of respondents had lived in their current region for 21 years and over (62%).

There was no significant difference in the likelihood of reporting poor health between current smokers and non-smokers, between those who had worked in mining and quarrying and those who had not, and between those who had never been unemployed and those who had been unemployed.

Table 17: Results of bivariate logistic regression analysis of individual demographic, social and economic characteristics and poor self-reported health, independent of region type: SHARE data combined for all continental European countries

Variable		**Odds Ratio (95% CI)**
Gender	Women Men	1.00 0.888**(0.816-0.966)
Age group	50-60 61-70 71-80 81+	1.00 1.292*** (1.155-1.434) 2.025*** (1.804-2.274) 3.372*** (2.841-4.002)
Marital status	Never married/cohabited Married/cohabited but not currently Married/cohabited still	1.00 1.455*** (1.174-1.802) 1.033 (0.845-1.263)
Age left education	22 years + 19-21 16-18 15 and under Never went to school	1.00 1.594***(1.344-1.891) 2.097*** (1.795-2.449) 3.334*** (2.849-3.902) 6.234*** (4.564-8.515)
Child Health Status	Good Poor	1.00 2.368*** (2.036-2.754)
Current smoker	No Yes	1.00 1.042 (0.934-1.164)
Length in current region	<5 years 6-10 11-15 16-20 21 and over	1.00 1.120 (0.881-1.424) 1.028 (0.12-1.303) 1.003 (0.791-1.272) 1.213* (1.008-1.461)
Job industry	Not worked in mining/quarrying Worked in mining/quarrying	1.00 1.200 (0.898-1.603)
Unemployed ever	No Yes	1.00 0.953 (0.812-1.119)

significance level: ***p<=0.001, **p<=0.01, *p<=0.05

6.1.3 Bivariate analysis of longstanding illness and individual predictor variables by country

The results of the analysis of individual level predictor variables on longstanding illness are presented in table 18. They show that across all countries there were again similar associations between self-reported health and some of the individual level predictor variables, though with varying levels of significance.

Older age groups were more likely to report they had a longstanding illness compared to younger individuals and the risk of reporting a longstanding illness was greater for individuals who left education at younger ages, indicating those in lower social classes were at greater risk of reporting a longstanding illness than those in higher social classes. In all countries apart from Poland, individuals who had poor health as a child were more likely to report they had a longstanding illness. There were no significant differences between the length of time individuals had resided in their current region and the likelihood of reporting a longstanding illness. In France, men were significantly more likely to report poor health than women.

There were mixed results across countries on the association between marital status and longstanding illness, individuals in England, who were married or co-habiting, were more likely to report having a longstanding illness than individuals who had never been married, while individuals in the Czech Republic were less likely to report a longstanding illness. In Poland and Spain individuals who were widowed or divorced were more likely to report a longstanding illness than individuals who had never married.

There were also mixed results for association between age left education and reporting longstanding illness. For example, in Belgium, there was no significant difference in the likelihood of reporting poor health between ages of when individuals left education, suggesting no socio-economic inequalities in health outcome. In France, Poland and Spain individuals who left education 15 years and under were significantly more likely to report a longstanding illness; while individuals in Germany and the Czech Republic who had left education 21 years and under were more likely to report a longstanding illness than those who had left education at an older age, results suggesting some socio-economic inequalities in health outcome.

In Poland and Spain the data again suggested that individuals who currently smoked were less likely to report they had a longstanding illness. Individuals in France who had worked in mining or quarrying were more likely to report a longstanding illness than individuals who had not worked in mining or quarrying. Individuals in Poland who had been unemployed were less likely to report poor health than those who had not been unemployed, while individuals in Belgium who had been unemployed were more likely to report a longstanding illness.

Table 18: Results of bivariate logistic regression analysis of individual demographic, social and economic characteristics and long standing illness: Individual country

Variable		England	Belgium	Czech Republic	France
		Odds Ratio (95% CI)	Odds Ratio (95% CI)	Odds Ratio (95% CI)	Odds Ratio (95% CI)
Gender	Women	1.00	1.00	1.00	1.00
	Men	0.987 (0.897-1.085)	0.930 (0.778-1.113)	1.103 (0.877-1.388)	1.226 * (1.012-1.486)
Age group	50-60	1.00	1.00	1.00	1.00
	61-70	1.632 *** (1.454-1.832)	1.157 (0.929-1.441)	1.160 (0.893-1.512)	1.742 *** (1.379-2.200)
	71-80	2.097 *** (1.844-2.386)	1.331* (1.045-1.696)	1.774 ** (1.271-2.476)	3.095 *** (2.361-4.059)
	81+	2.185 *** (1.819-2.624)	2.272*** (1.615-3.196)	2.504 ** (1.427-4.394)	4.307 *** (2.932-6.326)
Marital status	Never married/cohabited	1.00	1.00	1.00	1.00
	Married/cohabited but not currently	1.040 (0.807-1.348)	1.330 (0.837-2.115)	0.576 (0.238-1.390)	1.237 (0.842-1.815)
	Married/cohabited still	1.154 ** (0.518-0.844)	0.900 (0.579-1.398)	0.387* (0.164-0.914)	0.868 (0.608-1.238)
Age left education	22 years +	1.00	1.00	1.00	1.00
	19-21	1.050 (0.813-1.355)	1.093 (0.806-1.482)	1.811 ** (1.172-2.799)	1.091 (0.791-1.503)
	16-18	1.231* (1.007-1.505)	0.999 (0.751-1.332)	1.745 ** (1.182-2.577)	1.086 (0.813-1.452)
	15 and under	1.850*** (1.518-2.255)	1.314 (0.975-1.771)	2.154 *** (1.366-3.398)	1.816 *** (1.344-2.454)
	Never went to school	- - -	1.388 (0.413-4.663)	- - -	0.811 (0.341-1.898)
Child Health Status	Good	1.00	1.00	1.00	1.00
	Poor	2.226*** (1.897-2.613)	1.718** (1.213-2.432)	2.665 *** (1.557-4.562)	1.612 ** (1.172-2.218)
Current smoker	No	1.00	1.00	1.00	1.00
	Yes	1.105 (0.966-1.264)	1.120 (0.876-1.431)	0.838 (0.638-1.102)	0.828 (0.634-1.082)
Length in current region	<5 years	1.00	1.00	1.00	1.00
	6-10	1.048 (0.868-1.265)	1.234 (0.776-1.960)	1.418 (0.630-3.194)	0.729 (0.466-1.140)
	11-15	0.872 (0.717-1.061)	0.832 (0.529-1.310)	1.180 (0.569-2.447)	0.938 (0.599-1.468)
	16-20	0.884 (0.731-1.070)	1.148 (0.717-1.839)	1.371 (0.668-2.815)	0.995 (0.641-1.546)
	21 and over	1.038 (0.891-1.209)	0.866 (0.614-1.219)	1.218 (0.700-2.119)	0.919 (0.644-1.312)
Job industry	Not worked in mining/quarrying	1.00	1.00	1.00	1.00
	Worked in mining/quarrying	1.357 (0.803-2.295)	0.762 (0.305-1.902)	1.904 (0.790-4.594)	2.053 ** (1.190-3.540)
Unemployed ever	No	1.00	1.00	1.00	1.00
	Yes	1.103 (0.945-1.288)	1.552 * (1.096-2.198)	0.821 (0.463-1.455)	0.785 (0.563-1.093)

significance level: ***p<=0.001, **p<=0.01, *p<=0.05

Table 18: Results of bivariate logistic regression analysis of individual demographic, social and economic characteristics and long standing illness: Individual country

Variable		**Germany**	**Poland**	**Spain**
		Odds Ratio (95% CI)	**Odds Ratio (95% CI)**	**Odds Ratio (95% CI)**
Gender	Women	1.00	1.00	1.00
	Men	1.221 (0.972-1.534)	0.976 (0.781-1.219)	0.857 (0.679-1.081)
Age group	50-60	1.00	1.00	1.00
	61-70	1.309 * (1.002-1.710)	1.891 *** (1.465-2.442)	1.607 ** (1.193-2.166)
	71-80	1.573** (1.153-2.152)	3.453 *** (2.440-4.887)	2.623*** (1.921-3.582)
	81+	3.261*** (1.775-5.992)	3.405 *** (1.932-6.000)	4.001*** (2.533-6.336)
Marital status	Never married/cohabited	1.00	1.00	1.00
	Married/cohabited but not currently	1.495 (0.789-2.832)	2.138 * (1.046-4.369)	2.541 ** (1.459-4.424)
	Married/cohabited still	1.129 (0.629-2.026)	1.737 (0.883-3.417)	1.478 (0.941-2.323)
Age left education	22 years +	1.00	1.00	1.00
	19-21	1.471* (1.037-2.086)	1.446 (0.840-2.490)	1.520 (0.683-3.380)
	16-18	1.462* (1.075-1.987)	1.363 (0.814-2.282)	1.323 (0.731-2.395)
	15 and under	1.966*** (1.345-2.874)	2.150** (1.280-3.610)	2.233** (1.320-3.779)
	Never went to school	- - -	2.289 (0.430-12.183)	3.703*** (2.044-6.710)
Child Health Status	Good	1.00	1.00	1.00
	Poor	2.545 *** (1.683-3.850)	1.253 (0.798-1.966)	1.495 * (1.008-2.217)
Current smoker	No	1.00	1.00	1.00
	Yes	1.076 (0.791-1.464)	0.682 ** (0.528-0.880)	0.547 ***(0.398-0.752)
Length in current region	<5 years	1.00	1.00	1.00
	6-10	0.766 (0.408-1.438)	0.772 (0.319-1.868)	1.260 (0.630-2.521)
	11-15	0.860 (0.459-1.611)	1.302 (0.523-3.238)	1.107 (0.558-2.193)
	16-20	0.837 (0.432-1.622)	0.794 (0.349-1.806)	0.744 (0.376-1.472)
	21 and over	0.923 (0.546-1.559)	0.943 (0.473-1.881)	1.147 (0.810-2.484)
Job industry	Not worked in mining/quarrying	1.00	1.00	1.00
	Worked in mining/quarrying	1.392 (0.368-5.274)	0.975 (0.531-1.761)	0.987 (0.394-2.472)
Unemployed ever	No	1.00	1.00	1.00
	Yes	0.984 (0.678-1.430)	0.584 ** (0.398-0.857)	0.785 (0.465-1.327)

significance level: ***p<=0.001, **p<=0.01, *p<=0.05

6.1.4 Bivariate analysis of longstanding illness and individual predictor variables by country

The results of logistic regression analysis of individual demographic, social and economic characteristics and longstanding illness, as reported in table 19, show that as expected, older age groups were more likely to report a long standing illness when compared to younger individuals (50-60); for individuals who were 61-70 years risk of reporting longstanding illness was more than 50% greater; individuals who were 71-80 years were twice as likely and individuals who were 81+ years where two and a half times more likely to report a longstanding illness.

Individuals who had been separated, divorced or widowed were significantly more likely to report a longstanding illness than those who had never been married or never had a partner. There was no significant difference in reporting a longstanding illness between those who were currently married or living with a partner and those who never been married or never had a partner.

Compared to those who left education aged over 21 years old, risk of reporting a longstanding illness was 70% higher for individuals who had left education aged 15 and under and two and a quarter times greater for those who never went to school. Individuals who left school between 19-21 years however had higher odds of reporting a longstanding illness than those who left school between 16-18 years. These results suggest socio-economic inequalities in health for those in the lowest socio-economic position, but a mix picture for those in the higher socio-economic positions.

Those who reported poor health as a child were nearly twice as likely to report they currently had a longstanding illness compared with those who reported good health as children.

Finally, those who worked or had worked in mining and quarrying for most of their career were nearly 44% more likely to report a longstanding illness as individuals who had not.

There was no significant difference in the likelihood of reporting a longstanding illness between men and women, smokers and non-smokers, between those who had never been unemployed and those who had been unemployed, and the length of time an individual had lived in their current region.

Table 19: Results of bivariate logistic regression analysis of individual demographic, social and economic characteristics and longstanding illness, independent of region type: Whole dataset

Variable		**Odds Ratio (95% CI)**
Gender	Women Men	1.00 1.019 (0.957-1.086)
Age group	50-60 61-70 71-80 81+	1.00 1.529*** (1.417-1.650) 2.072*** (1.900-2.259) 2.551*** (2.244-2.900)
Marital status	Never married/cohabited Married/cohabited but not currently Married/cohabited still	1.00 1.262** (1.072-1.487) 0.884 (0.758-1.031)
Age left education	22 years + 19-21 16-18 15 and under Never went to school	1.00 1.272*** (1.114-1.452) 1.223*** (1.091-1.371) 1.705*** (1.522-1.911) 2.252*** (1.680-3.021)
Child Health Status	Good Poor	1.00 1.960*** (1.752-2.194)
Current smoker	No Yes	1.00 0.971 (0.892-1.057)
Length in current region	<5 years 6-10 11-15 16-20 21 and over	1.00 1.026 (0.885-1.190) 0.934(0.804-1.084) 0.939 (0.810-1.088) 1.100 (0.98-1.235)
Job industry	Not worked in mining/quarrying Worked in mining/quarrying	1.00 1.439** (1.106-1.873)
Unemployed ever	No Yes	1.00 1.000 (0.895-1.118)

significance level: ***p<=0.001, **p<=0.01, *p<=0.05

6.2 How far do individual demographic, socio-economic and health risk characteristics help explain the hypothesised coalfield effect on health outcomes?

This second phase of analysis used multivariate logistic regression analysis to assess the combined impact of individual demographic, health and socio-economic characteristics on the likelihood of reporting poor health or having a longstanding illness; and to see if individual characteristics could account for the ‘coalfield effect’ on the health outcomes reported above. If so, this would suggest that health differences between coalfield and non-coalfield regions could be accounted for by individual risk factors associated with the differing composition of the populations who inhabit those regions.

The multivariate logistic regression analysis was built up in five stages (four stages for the England only data, for the poor health outcome variable). The first stage of the model was the bivariate analysis of the health outcome variable and coalfield region. The second stage brought into the model the country-region interaction term, this would ensure the country variations in the relationship between health outcome and coalfield regions identified above were accounted for. The third stage entered into the model a group of variables describing fundamental human demographic characteristics; age group, gender and marital status. The fourth stage added child health and current smoker variables, selected to describe life course and current behavioural health risk factors. The final set of variables added to the model reflected social and environmental conditions individuals had been subject to through their life course; age left education, a proxy for social class describing the social background individuals had experienced; length of time lived in current region, being an indicator for the length of time individuals had been exposed to social and cultural environmental conditions of their current region and also an proxy indicator for economic migration, and finally economic environmental conditions individuals were exposed to in the form of working in mining or quarrying for most of their career and if an individual had ever been unemployed.

After each run of the analysis for each model, the change in the odds ratio for having a longstanding illness or poor health in a coalfield region was assessed, to see how far each new group of predictor variables might account for the differences in health between coalfield and non-coalfield regions.

6.2.1 Multivariate logistic regression analysis for poor health: European countries

The results of the regression analysis are reported in table 20. Models 2 to 5 are statistically significant at the p=0.001 level. Model 1 is only statistically significant at the p=0.10 level. Compared with model 1 each additional run of the model resulted in a significant change in log-likelihoods, as tested using the likelihood ratio test. For models 1 to 4 this was a significant reduction in log-likelihoods, however between model 4 and 5 there was a slight increase in log-likelihoods. However, overall, between model 1 and 5 there was a significant reduction in log-likelihood of 594.63. This indicates that the country of residence, demographic and health characteristics of individuals have significant power to predict self-reported poor health for the European countries. The results of model 5 show that adjusting for individual characteristics increased the coalfield effect of greater likelihood of reporting poor health. The pseudo R^2 of model 5 reports that approximately 10% of the variability in reporting poor health is explained by the model.

Results from model 2 show that adding the country/region interaction term has the result of increasing the coalfield region odds ratio to a significant level, showing that, controlling for variation in reporting of poor health across countries, the odds of reporting poor health is 38%

higher given residence in a coalfield region compared to living in a non-coalfield region (OR 1.38; 95%CI 1.12 – 1.70, p=0.002). This indicates that without controlling for country differences in reporting poor health, the coalfield effect associated with poor health would be underestimated.

Model 3 adds the demographic characteristics of individuals. Controlling for these factors has the result of increasing the coalfield region odds ratio compared with model 2, with the odds of reporting poor health now being nearly 42% higher given residence in a coalfield region compared to living in a non-coalfield region (OR 1.42; 95%CI 1.15 – 1.75, p=0.000). This suggests that before controlling for these demographic variables, the coalfield effect is reduced because there is a younger population in coalfield areas. On investigating the data further this was found to be the case.

Model 4 added individual life course and current health risk variables. Controlling for these factors had the result of again increasing the coalfield odds ratio form model 3, with the odds of reporting poor health being 43% higher given higher given residence in a coalfield region compared to living in a non-coalfield region (OR 1.43; 95%CI 1.16 – 1.77, p=0.000).

The results for model 5 show that after controlling for all individual characteristics which might help explain health variation between coalfield regions and non-coalfield regions, living in a coalfield region was associated with a statistical significant greater likelihood of reporting poor health (OR 1.56; 95%CI 1.26 – 1.93, p=0.000).

Summarising the results of model 5, compared with Belgium, individuals from all other countries were more likely to report poor health. Individuals in Poland were nearly six times more likely to report poor health than individuals in Belgium. Individuals in German and Polish coalfield regions were less likely to report poor heath than individuals in Belgium coalfield regions.

As expected, older individuals were more likely to report poor health than younger individuals (50-60 years). Those aged 71-80 years were twice as likely to report poor health and individuals 81+ years nearly three and a half times more likely to report poor health, than individuals aged 50-60 years.

For socio-economic position, as measured by age left education, those who left education at 15 years and under, or never went to school, were more likely to report poor health than those who left school 16 years and over. However, individuals who left education between 19 and 21 years were still more likely to report poor health than those who stayed on at education after 21 years of age.

Those who had poor health as a child were two and a half times more likely to report poor health as an adult than those who reported they had good health as a child. Those who reported they currently smoke were 21% more likely to report poor health than individuals who did not currently smoke.

There were no significant differences in reporting poor health between those who had not been unemployed and those who had; those who had not worked in mining and quarrying and those who had; the length of time an individual had lived in their current region; between the marital status groups or between women and men.

Table 20: Logistic regression models of poor health testing for demographic, health and socio-economic factors: Combined European countries

Group	**Variable**		**Bivariate analysis 1**	**Model 2 Country/Region interaction**	**Model 3 Demographic factors**	**Model 4 Demographic and health risk factors**	**Model 5 Demographic, health risk & socio-economic factors**
			Odds Ratio (95% CI)	**Odds Ratio (95% CI)**	**Odds Ratio (95% CI)**	**Odds Ratio (95% CI)**	**Odds Ratio (95% CI)**
Region type	Current region	Non-coalfield region	1.00	1.00	1.00	1.00	1.00
		Coalfield region	1.090[1] (0.984-1.208)	1.384 **(1.127-1.700)	1.419 ***(1.149-1.752)	1.434***(1.160-1.774)	1.557***(1.256-1.931)
Country /region interaction	Country	Belgium		1.00	1.00	1.00	1.00
		Czech Rep		1.993*** (1.677-2.369)	2.143***(1.794-2.558)	2.178***(1.821-2.604)	2.305***(1.922-2.764)
		France		1.497***(1.275-1.758)	1.531***(1.300-1.805)	1.500***(1.268-1.768)	1.536***(1.300-1.819)
		Germany		2.042***(1.721-2.424)	2.223***(1.866-2.650)	2.134***(1.788-2.549)	2.352***(1.963-2.817)
		Poland		5.171 ***(4.345-6.154)	6.030***(5.042-7.213)	6.127***(5.115-7.338)	5.833***(4.857-7.005)
		Spain		2.717 ***(2.274-3.247)	2.800***(2.330-3.360)	2.773***(2.306-3.334)	2.067***(1.697-2.516)
	Country/ coalfield region	Belgium/coalfield region		1.00	1.00	1.00	1.00
		Czech Rep/coalfield region		0.721 (0.500-1.041)	0.743 (0.511-1.081)	0.722 (0.495-1.052)	0.688 (0.470-1.008)
		France/coalfield region		1.316 (0.922-1.879)	1.227 (0.851-1.770)	1.250 (0.863-1.809)	1.049 (0.720-1.527)
		Germany/coalfield region		0.597** (0.433-0.845)	0.587** (0.412-0.837)	0.594**(0.416-0.850)	0.533*** (0.371-0.765)
		Poland/coalfield region		0.600** (0.432-0.833)	0.615** (0.440-0.859)	0.610**(0.436-0.855)	0.577**(0.411-0.812)
		Spain/coalfield region		0.859 (0.612-1.206)	0.833 (0.589-1.180)	0.812 (0.572-1.154)	0.771 (0.540-1.103)
Demography	Gender	Women			1.00	1.00	1.00
		Men			0.888** (0.811-0.973)	0.887** (0.809-0.973)	0.934 (0.850-1.027)
	Age group	50-60			1.00	1.00	1.00
		61-70			1.366***(1.226-1.522)	1.394***(1.249-1.557)	1.348***(1.204-1.510)
		71-80			2.201***(1.948-2.487)	2.311***(2.039-2.620)	2.089 ***(1.833-2.380)
		81+			3.721***(3.104-4.461)	3.950***(3.281-4.753)	3.476***(2.871-4.209)
	Marital status	Never married/cohabited			1.00	1.00	1.00
		Widowed/separated/ divorced			1.170 (0.931-1.469)	1.186 (0.943-1.493)	1.131 (0.896-1.427)
		Married/cohabited still			0.908 (0.735-1.122)	0.938 (0.758-1.162)	0.918 (0.740-1.140)
Health risk	Child Health	Good				1.00	1.00
		Poor				2.569***(2.192-3.011)	2.550***(2.173-2.993)

Group	Variable		Bivariate analysis 1	Model 2 Country/Region interaction	Model 3 Demographic factors	Model 4 Demographic and health risk factors	Model 5 Demographic, health risk & socio-economic factors
			Odds Ratio (95% CI)	Odds Ratio (95% CI)	Odds Ratio (95% CI)	Odds Ratio (95% CI)	Odds Ratio (95% CI)
Health risk	Current smoker	No Yes				1.00 1.219*** (1.080-1.374)	1.00 1.208** (1.070-1.363)
Socio-economic	Age left education	22 years + 19-21 16-18 15 and under Never went to school					1.00 1.467***(1.226-1.756) 1.851***(1.571-2.180) 2.518***(2.121-2.990) 4.417***(3.132-6.229)
	Length in current region	<5 years 6-10 11-15 16-20 21 and over					1.00 1.116 (0.864-1.441) 1.034 (0.803-1.331) 0.940 (0.729-1.211) 0.943 (0.771-1.153)
	Job industry	Not worked in mining Worked in mining					1.00 1.001 (0.733-1.367)
	Unemployed ever	No Yes					1.00 1.128 (0.947-1.342)
Log-likelihood			-6032.191	-5777.083	-5593.068	-5517.530	5437.563
Difference in log-likelihood between each model			--	Model 1 and 2 255.108	Model 2 and 3 184.015	Model 3 and 4 75.538	Model 4 and 5 79.967
Likelihood-ratio test between each model			--	Model 1 and 2 LR chi2(10) = 510.21 Prob > chi2 = 0.000	Model 2 and 3 LR chi2(6) = 368.03 Prob > chi2 = 0.000	Model 3 and 4 LR chi2(2) = 151.08 Prob > chi2 = 0.000	Model 4 and 5 LR chi2(10) = 159.93 Prob > chi2 = 0.000
Whole model Statistical significance (Prob > chi2)			0.098	0.000	0.000	0.000	0.000
Pseudo R^2			0.0002	0.0425	0.0730	0.0855	0.0988
Difference in log-likelihood between model 1 and 5 Significance of likelihood-ratio test between model 1 and model 5			--	--	--	--	594.628 LR chi2(28) = 1189.26 Prob > chi2 = 0.000

significance level: ***p<=0.001, **p<=0.01, *p<=0.05, [1]p<=0.10

6.2.2 Multivariate logistic regression analysis for poor health: England

The results of the regression analysis are reported in table 21. Each of the 4 models are statistically significant at the p=0.001 level. Compared with model 1 each additional run of the model resulted in a significant reduction in log-likelihoods, as tested using the likelihood ratio test. Between model 1 and 4 there was a significant reduction in log-likelihood of 288.09. This indicates that the demographic, health and socio-economic characteristics of individuals have significant power to predict self-reported poor health for England. The results of model 4 show that adjusting for individual characteristics decreased the coalfield effect of greater likelihood of reporting poor health. The pseudo R^2 of model 4 reports that approximately 7% of the variability in reporting poor health is explained by the model.

Results from model 2 show that adding the demographic characteristics of individuals has the result of significantly increasing the coalfield region odds ratio, showing that the odds of reporting poor health is 35% higher given residence in a coalfield region compared to living in a non-coalfield region (OR 1.35; 95%CI 1.22 – 1.50, p=0.000). This indicates that without controlling for demographic differences in reporting poor health, the coalfield effect associated with poor health would be underestimated.

Model 3 added individual life course and current health risk variables. Controlling for these factors had the result of reducing the coalfield odds ratio from model 2, with the odds of reporting poor health being 33% higher given higher given residence in a coalfield region compared to living in a non-coalfield region (OR 1.33; 95%CI 1.20 – 1.49, p=0.000).

The results for model 4 show that after controlling for all individual characteristics which might help explain health variation between coalfield regions and non-coalfield regions, living in a coalfield region was associated with a statistical significant greater likelihood of reporting poor health (OR 1.23; 95%CI 1.10 – 1.37, p=0.000).

Summarising the results of model 4, as expected, older individuals were more likely to report poor health than younger individuals (50-60 years). Those aged 71-80 years were nearly one and a half times more likely to report poor health and individuals 81+ years nearly two times more likely to report poor health, than individuals aged 50-60 years.

For socio-economic position, as measured by age left education, those who left education at 15 years and under, were three times more likely to report poor health than those who left education after 21 years of age. However, individuals who left education between 19 and 21 years were still one and a half times more likely to report poor health than those who stayed on at education after 21 years of age.

Those who had poor health as a child were two and a quarter times more likely to report poor health as an adult than those who reported they had good health as a child. Those who reported they currently smoke nearly two times more likely to report poor health than individuals who did not currently smoke. Individuals who were currently married or co-habiting were less likely to report poor health than individuals who had always been single and lived alone.

There were no significant differences in reporting poor health between those who had not been unemployed and those who had; those who had not worked in mining and quarrying and those who had; the length of time an individual had lived in their current region and between women and men.

An interesting point to note is that although for the European country model, controlling for socio-economic factors seemed to make the 'coalfield effect' more pronounced, in the England model, the reverse was found. This could be possibly due to more of the health disadvantage for those living in coalfields in England being accounted for by their relatively disadvantaged position in socio-economic terms.

Table 21: Logistic regression models of poor health testing for demographic, health and socio-economic factors: England

Group	Variable		Bivariate analysis 1	Model 2 Demographic factors	Model 3 Demographic & health risk factors	Model 4 Demographic, health risk & socio-economic factors
			Odds Ratio (95% CI)	**Odds Ratio (95% CI)**	**Odds Ratio (95% CI)**	**Odds Ratio (95% CI)**
Region type	Current region	Non-coalfield region Coalfield region	1.00 1.337*** (1.206-1.483)	1.00 1.352 ***(1.217-1.502)	1.00 1.334***(1.199-1.485)	1.00 1.230***(1.103-1.372)
Demography	Gender	Women Men		1.00 1.063 (0.954-1.183)	1.00 1.069 (0.958-1.193)	1.00 1.037 (0.927-1.160)
	Age group	50-60 61-70 71-80 81+		1.00 1.354***(1.188-1.543) 1.749***(1.521-2.011) 2.120***(1.747-2.571)	1.00 1.416***(1.239-1.619) 1.913***(1.657-2.208) 2.473***(2.028-3.016)	1.00 1.280***(1.116-1.467) 1.568***(1.349-1.823) 1.982***(1.614-2.435)
Health risk	Marital status	Never married/cohabited Widowed/separated/divorced Married/cohabited still		1.00 0.982 (0.757-1.276) 0.603*** (0.469-0.774)	1.00 0.991 (0.759-1.293) 0.661***(0.512-0.853)	1.00 0.905 (0.690-1.188) 0.627***(0.483-0.813)
	Child Health Status	Good Poor			1.00 2.339***(2.004-2.729)	1.00 2.258***(1.931-2.640)
	Current smoker	No Yes			1.00 1.997*** (1.727-2.210)	1.00 1.807*** (1.559-2.094)
Socio-economic	Age left education	22 years + 19-21 16-18 15 and under				1.00 1.529*(1.067-2.190) 1.803***(1.344-2.420) 3.158***(2.364-4.219)
	Length in current region	<5 years 6-10 11-15 16-20 21 and over				1.00 1.125 (0.907-1.396) 1.018 (00.810-1.279) 1.001(0.805-1.258) 1.130 (0.947-1.350)

Group	Variable		Bivariate analysis 1	Model 2 Demographic factors	Model 3 Demographic & health risk factors	Model 4 Demographic, health risk & socio-economic factors
			Odds Ratio (95% CI)	**Odds Ratio (95% CI)**	**Odds Ratio (95% CI)**	**Odds Ratio (95% CI)**
Socio-economic	Job industry	Not worked in mining Worked in mining				1.00 2.134 (1.245-3.657)
	Unemployed ever	No Yes				1.00 1.090 (0.913-1.300)
Log-likelihood			-4196.285	-4087.752	-3988.531	3908.197
Difference in log-likelihood between each model			--	Model 1 and 2 108.533	Model 2 and 3 99.221	Model 3 and 4 80.334
Likelihood-ratio test between each model			--	Model 1 and 2 LR chi2(6) = 217.07 Prob > chi2 = 0.000	Model 2 and 3 LR chi2(2) = 198.44 Prob > chi2 = 0.000	Model 3 and 4 LR chi2(9) = 160.67 Prob > chi2 = 0.000
Whole model Statistical significance (Prob > chi2)			0.000	0.000	0.000	0.000
Pseudo R^2			0.0036	0.0294	0.0529	0.0720
Difference in log-likelihood between model 1 and 4 Significance of likelihood-ratio test between model 1 and model 4			--	--	--	288.09 LR chi2(17) = 576.18 Prob > chi2 = 0.000

significance level: ***p<=0.001, **p<=0.01, *p<=0.05

6.3 Multivariate logistic regression analysis for longstanding illness: Combined dataset

The results of the regression analysis on data from ELSA and SHARE combined are reported in table 22. Each of the models 2 to 5 are statistically significant at the 0.001 level, as reported by prob>chi2. Compared with model 1, which contained no demographic, socio-economic and health risk predictor variables, each additional run of the model, which added the groups of individual characteristic predictor variables, resulted in a significant reduction in log-likelihoods, as tested using the likelihood ratio test. Between model 1 and model 5, there was a significant reduction in log likelihood of 454.03. This indicates that all the combinations of predictor variables chosen to represent demographic, health and socio-economic circumstances of individuals have significant power to predict individual self-reported longstanding illness. The results of model 5 show that adjusting for individual characteristics, reduced, but did not explain away, the coalfield effect of the greater likelihood of reporting a longstanding illness. The pseudo R^2 of model 5 reports that approximately 4.3% of variability in reporting longstanding illness is explained by the model.

Results from model 2 show that adding the country/region interaction term to the bivariate model 1 has the result of increasing the significance of the coalfield region odds ratio, showing that the odds of reporting a longstanding illness is almost a third higher given residence in a coalfield region, compared to living in a non-coalfield region (OR: 1.32; 95%CI: 1.20-1.45, p=0.000). This indicates that without controlling for country differences in illness reporting, the coalfield effect of reporting a longstanding illness would be underestimated. As indicated in the bivariate analyses reported above, compared to England, individuals in all countries apart from Belgium were significantly more likely to report a longstanding illness, with individuals in Germany and Poland reporting more noticeable differences. Individuals in Germany and Poland were more likely to report a longstanding illness than individuals in England. Compared to those living in English coalfield regions, there is a lower risk of reporting illness among those from coalfield areas in Germany and Poland. Model 2 shows that after allowing for the situation in Germany and Poland, across the rest of the sample, we see more clearly that those in coalfield areas are more likely to report illness.

Model 3 adds the demographic characteristics of individuals to the model, including their age, sex and marital status. Controlling for these demographic factors has the result of slightly increasing the coalfield region odds ratio from model 2, with the odds of reporting a longstanding illness being just over a third higher given residence in a coalfield region, compared to living in a non-coalfield region (OR: 1.34; 95%CI: 1.22-1.47, p=0.000). Sex and marital status had no statistical significant influence in the model, but the age group variable is significant.

As with the bivariate analysis; there was no significant difference in reporting a longstanding illness between men and women, and older age groups were more likely to report a long standing illness when compared to younger individuals. However, compared to the bivariate analysis, there was now no significant difference in reporting a longstanding illness between individuals who had been separated, divorced or widowed and those who had never been married or cohabited; this change in significance is probably due to controlling for age. The chi square test shows that relatively older respondents, 71 years and over, and relatively fewer respondents 50-60 years old, were widowed, separated or divorced. This probably reflects that as individuals get older, the more likely they are to become widowed.

Model 4 added individual life course and current health risk variables into the model, self-rated health as a child and whether the person is currently a smoker. Adding these variables had no marked influence on the coalfield odds ratio (OR: 1.34; 95%CI: 1.21-1.47, p=0.000). After controlling for the other variables in the model, individuals who reported they had poor health as a child were more likely to have a long standing illness than those who reported they had good health as a child. There was no difference in the likelihood of reporting a longstanding illness between current smokers and those who did not smoke.

The results of the Model 5 show that, after controlling for all individual characteristic variables which might explain health variation between coalfield and non-coalfield regions, living in a coalfield region was significantly associated with a greater likelihood of reporting a long standing illness (OR: 1.30; 95%CI: 1.18-1.43, p=0.000), after controlling additionally for socio-economic variables. The odds ratio associated with residence in a coalfield area fell slightly compared with Model 4, from 1.336 to 1.3, suggesting that some of the differences between coalfield regions and other areas were explained by the significantly greater risk of reporting illness for those with lower education levels and those who had experienced unemployment during their lives. Length of time the person had living in their present area of residence did not explain variation in illness.

The findings from this data investigation suggested that differences in health outcomes between coalfield and non-coalfield residents are still apparent after taking into account individual characteristics.

Table 22: Logistic regression models of longstanding illness testing for demographic, health and socio-economic factors: Whole dataset

Group	Variable		Bivariate analysis 1	Model 2 Country/Region interaction	Model 3 Demographic factors	Model 4 Demographic & health risk factors	Model 5 Demographic, health risk & socio-economic factors
			Odds Ratio (95% CI)	Odds Ratio (95% CI)	Odds Ratio (95% CI)	Odds Ratio (95% CI)	Odds Ratio (95% CI)
Region type	Current region	Non-coalfield region	1.00	1.00	1.00	1.00	1.00
		Coalfield region	1.102**(1.031-1.177)	1.320 ***(1.201-1.452)	1.338 ***(1.215-1.473)	1.336***(1.212-1.472)	1.300***(1.178-1.433)
Country /region interaction	Country	England		1.00	1.00	1.00	1.00
		Belgium		0.907 (0.798-1.031)	0.863**(0.758-0.983)	0.882 (0.774-1.005)	0.922 (0.807-1.053)
		Czech Rep		1.300***(1.129-1.496)	1.281***(1.110-1.477)	1.321***(1.144-1.525)	1.428***(1.233-1.655)
		France		1.142 *(1.011-1.291)	1.102 (0.973 -1.248)	1.107 (0.977-1.255)	1.160* (1.022-1.318)
		Germany		1.954 ***(1.692-2.256)	1.953***(1.688-2.260)	1.941***(1.676-2.248)	2.112***(1.818-2.454)
		Poland		2.245 ***(1.943-2.594)	2.352***(2.031-2.723)	2.410***(2.080-2.793)	2.437***(2.097-2.833)
		Spain		1.319***(1.138-1.530)	1.255**(1.080-1.459)	1.265* (1.088-1.472)	1.150 (0.979-1.351)
	Country/ coalfield region	England/coalfield region		1.00	1.00	1.00	1.00
		Belgium/coalfield region		0.870 (0.7027-1.078)	0.876 (0.705-1.088)	0.880 (0.707-1.094)	0.927 (0.745-1.155)
		Czech Rep/coalfield region		1.012 (0.731-1.401)	1.043 (0.750-1.449)	1.032 (0.742-1.437)	1.067 (0.7660-1.487)
		France/coalfield region		0.983 (0.721-1.339)	0.934 (0.682-1.280)	0.944 (0.688-1.296)	0.923 (0.672-1.268)
		Germany/coalfield region		0.680* (0.503-0.919)	0.691* (0.509-0.937)	0.703* (0.518-0.955)	0.713* (0.525-0.969)
		Poland/coalfield region		0.578 ***(0.438-0.761)	0.598***(0.452-0.791)	0.601***(0.455-0.796)	0.615***(0.464-0.815)
		Spain/coalfield region		0.942 (0.704-1.262)	0.910 (0.677-1.223)	0.897 (0.666-1.207)	0.934 (0.693-1.259)
Demography	Gender	Women			1.00	1.00	1.00
		Men			1.042 (0.975-1.113)	1.050 (0.983-1.122)	1.056 (0.987-1.130)
	Age group	50-60			1.00	1.00	1.00
		61-70			1.508***(1.396-1.629)	1.508***(1.394-1.629)	1.479***(1.137-1.601)
		71-80			2.031***(1.859-2.219)	2.044***(1.869-2.237)	1.948***(1.774-2.138)
		81+			2.452***(2.147-2.800)	2.481***(2.168-2.839)	2.326***(2.026-2.670)
	Marital status	Never married/cohabited			1.00	1.00	1.00
		Widowed/separated/divorced			1.123 (0.949-1.329)	1.413 (0.965-1.354)	1.112 (0.938-1.318)
		Married/cohabited still			0.868 (0.741-1.016)	0.893 (0.762-1.046)	0.887 (0.757-1.010)

Group	Variable		Bivariate analysis 1	Model 2 Country/Region interaction	Model 3 Demographic factors	Model 4 Demographic & health risk factors	Model 5 Demographic, health risk & socio-economic
Health risk	Child health status	Good Poor				1.00 1.968***(1.755-2.208)	1.00 1.938***(1.727-2.174)
	Current smoker	No Yes				1.00 1.058 (0.968-1.158)	1.00 1.035 (0.946-1.133)
Socio-economic	Age left education	22 years + 19-21 16-18 15 and under Never went to school					1.00 1.249***(1.089-1.433) 1.201**(1.065-1.353) 1.506***(1.332-1.703) 1.827***(1.328-2.513)
	Length in current region	<5 years 6-10 11-15 16-20 21 and over					1.00 1.020 (0.877-1.188) 0.945 (0.810-1.102) 0.954 (0.820-1.111) 0.946 (0.837-1.068)
	Job industry	Not worked in mining Worked in mining					1.00 1.215 (0.926-1.596)
	Unemployed ever	No Yes					1.00 1.130* (1.006-1.270)
Log-likelihood			-10750.893	-10631.212	-10402.362	-10330.861	-10296.862
Difference in log-likelihood between each model			--	Model 1 and 2 119.681	Model 2 and 3 228.85	Model 3 and 4 71.501	Model 4 and 5 33.999
Likelihood-ratio test between each model			--	Model 1 and 2 LR chi2(12) = 239.36 Prob > chi2 = 0.000	Model 2 and 3 LR chi2(6) = 457.70 Prob > chi2 = 0.000	Model 3 and 4 LR chi2(2) = 143.00 Prob > chi2 = 0.000	Model 4 and 5 LR chi2(10) = 68.00 Prob > chi2 = 0.000
Whole model Statistical significance (Prob > chi2)			0.004	0.000	0.000	0.000	0.000
Pseudo R^2			0.000	0.012	0.0328	0.0394	0.0426
Difference in log-likelihood between model 1 and 5 Significance of likelihood-ratio test between model 1 and model 5			--	--	--	--	454.031 LR chi2(30) = 908.06 Prob > chi2 = 0.000

significance level: ***p<=0.001, **p<=0.01, *p<=0.05

CHAPTER 7

7 How far do socio-economic, political and environmental characteristics of regional contexts help explain the hypothesised coalfield effect on health outcomes?

The findings from the bivariate and multiple regression analysis above established that there seemed to be an additional risk of illness for those living in coalfields in all countries, apart from Germany and Poland, after individual demographic, socio-economic and health factors were accounted for.

The final stage of data analysis was carried out to investigate how socio-economic, political and environmental characteristics of coalfield regions may contribute to the health outcomes of individuals living in these areas and how they may help explain the continuing coalfield effect on health outcomes in some countries and why in others there were no such coalfield effects.

7.1 Graphical assessment of contextual characteristics of coalfield regions against national averages

The nature of the contextual characteristics of the coalfield regions were assessed graphically through the use of trend graphs and bar charts, which show how contextual characteristics of coalfield regions compare with the national conditions in their mother country. In addition, by looking across graphs, it is possible to see how coalfields in one country fair compared to other coalfield regions in a different country.

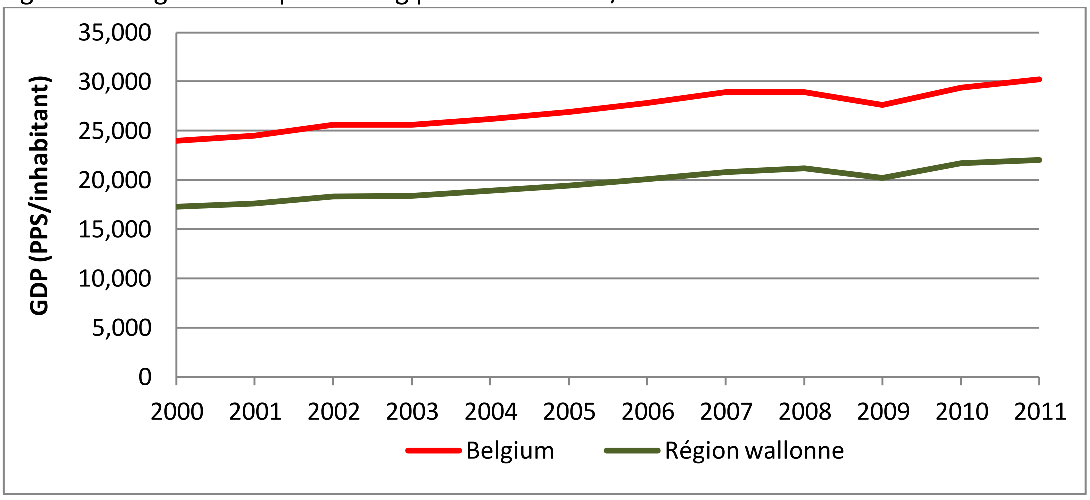
7.1.1 Regional wealth

Gross domestic product (GDP) per inhabitant was chosen as an indicator to represent the wealth of each country and region. The study's conceptual framework proposes that wealth in an area would be likely to be associated with health for all those living in the area, and other things being equal, those living in wealthier areas would be expected to have better health. Figures 9 to 15 show the trend of GDP per inhabitant for each of the countries in the study.

Over the 12 year period for which data were easily available, Spain, the Czech Republic and Poland consistently had the lowest GDP of the study countries. Belgium, UK, Germany and

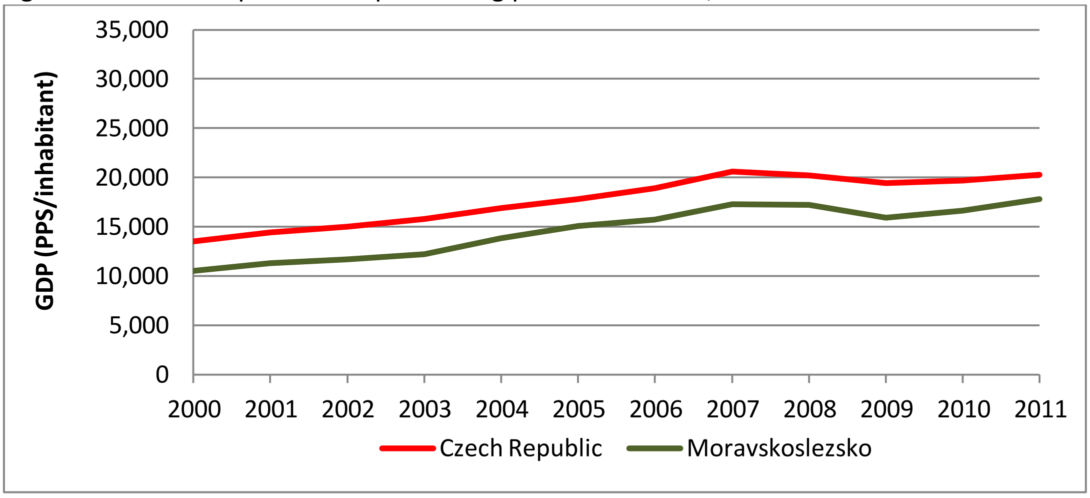
France appear to be the wealthier countries in the study. However there were differences in how each country was affected by the 2007-2009 economic downturn. Falls of GDP in France and the UK started in 2007, falling to a low in 2009, for France the fall was followed by a recovery to near pre-economic downturn levels in 2011, for the UK, GDP remained stable at 2009 levels. Belgium and Spanish GDP tended to plateau between 2007 and 2008, and then fell in 2009; while Belgium GDP rose to above pre-economic downturn rates in 2011, GPD in Spain remained similar to 2009 levels. For the Czech Republic, GDP fell only very slightly between 2007 and 2009, with a gradual rise again to pre-economic downturn levels in 2011. Germany's GDP was still rising, all be it at a slower rate in 2008, then fell notably in 2009, but post economic downturn has recovered steadily, to slightly above pre-economic downturn levels. Poland's GDP plateaued during the economic downturn, with post 2009 levels rising at rates similar to that pre-2007. Most coalfield regions had GDP's consistently below that of their mother country, but followed a similar pattern of growth. The exceptions to this are the Dolnoslaskie and Slaskie coalfield regions of Poland and the Aragon coalfield region in Spain, having GDP's above that of their mother countries. In Germany, the North Rhine Westphalia coalfield region consistently has a similar GDP over the time period to Germany as a whole.

Figure 9: Belgium GDP purchasing power standard / inhabitant 2000 - 2011



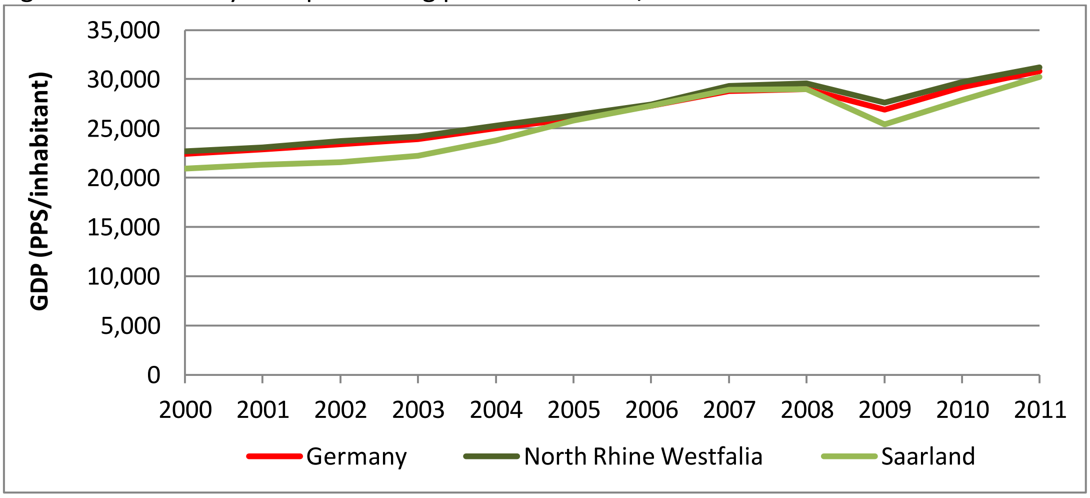
Data source: Eurostat General and Regional Statistics data base

Figure 10: Czech Republic GDP purchasing power standard / inhabitant 2000 - 2011



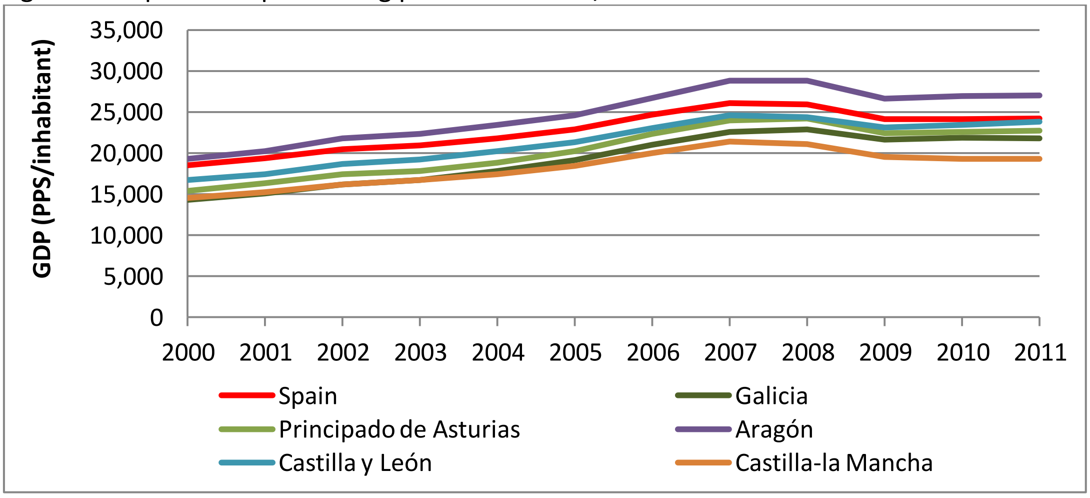
Data source: Eurostat General and Regional Statistics data base

Figure 11: Germany GDP purchasing power standard / inhabitant 2000 - 2011



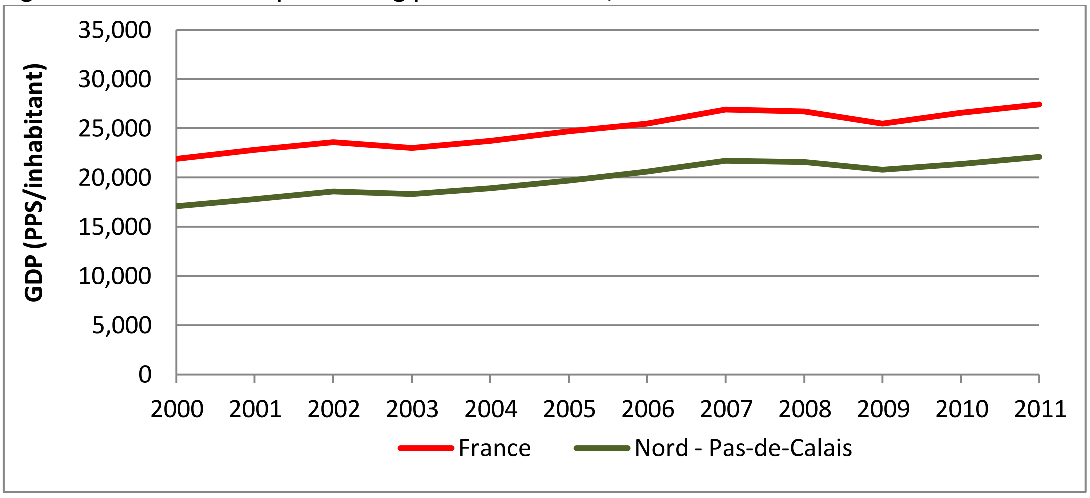
Data source: Eurostat General and Regional Statistics data base

Figure 12: Spain GDP purchasing power standard / inhabitant 2000 - 2011



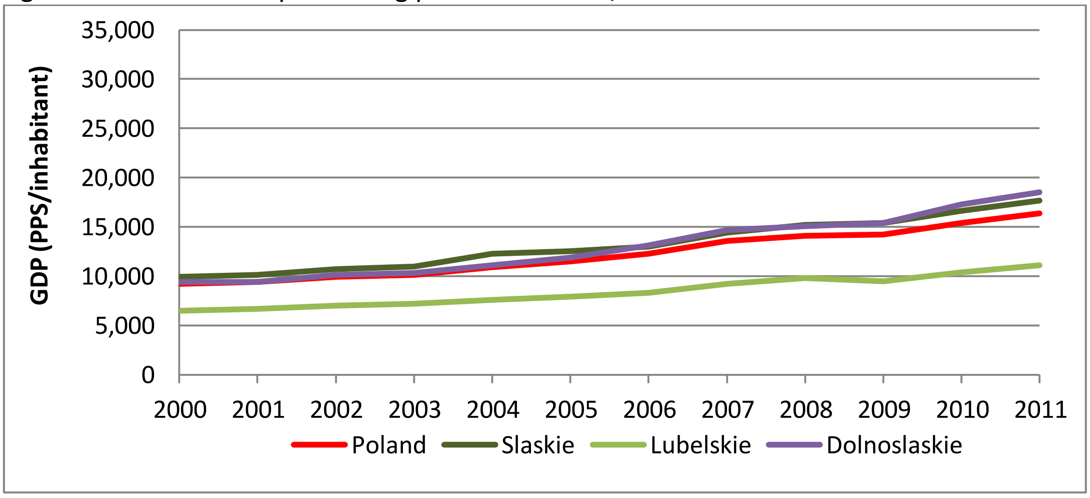
Data source: Eurostat General and Regional Statistics data base

Figure 13: France GDP purchasing power standard / inhabitant 2000 - 2011



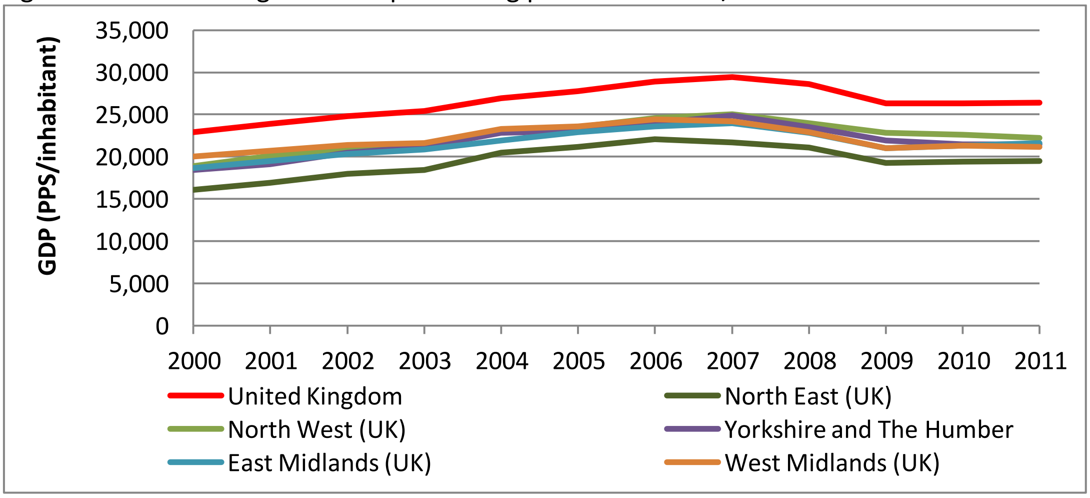
Data source: Eurostat General and Regional Statistics data base

Figure 14: Poland GDP purchasing power standard / inhabitant 2000 - 2011



Data source: Eurostat General and Regional Statistics data base

Figure 15: United Kingdom GDP purchasing power standard / inhabitant 2000 - 2011

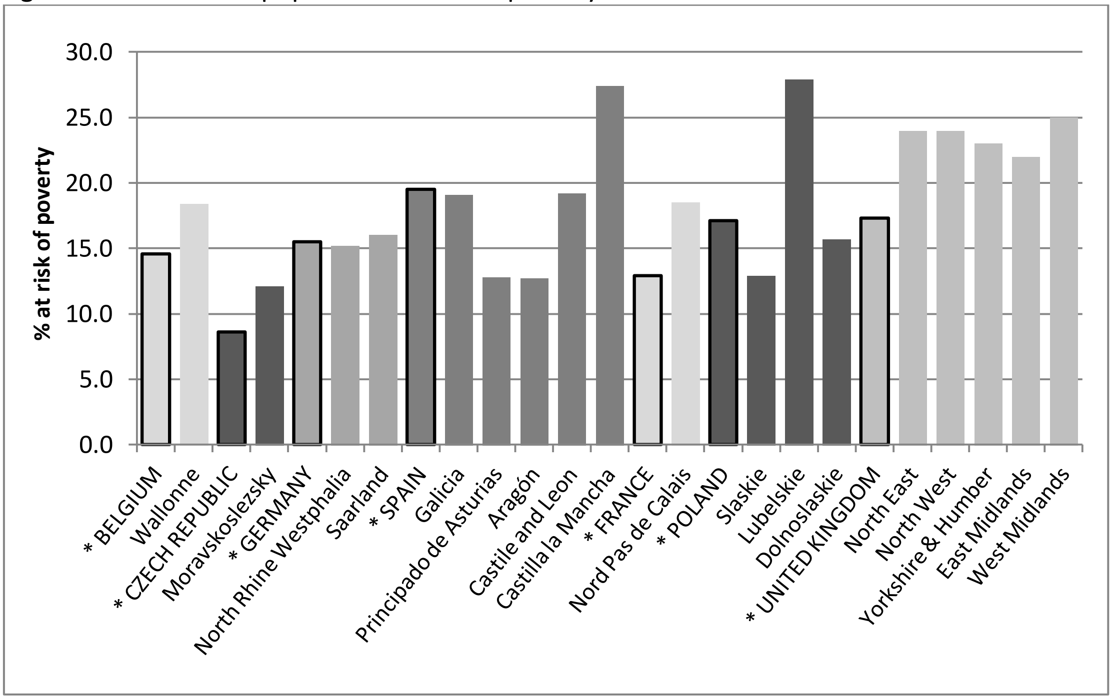


Data source: Eurostat General and Regional Statistics data base

7.1.2 Social deprivation

At risk of poverty rate was the closest measure that was easily accessible that gave an indication of the level of social deprivation experienced within regions. However, the measure is more accurately expressed as a measure of income inequality, rather than a direct measure of poverty. For each country the poverty threshold is set at 60% of the median income for that country. It was not possible to report trends over time due to data incompleteness, however data for 2009 were available for all regions and are presented graphically in figure 16.

Figure 16: Percent of population at risk of poverty 2009



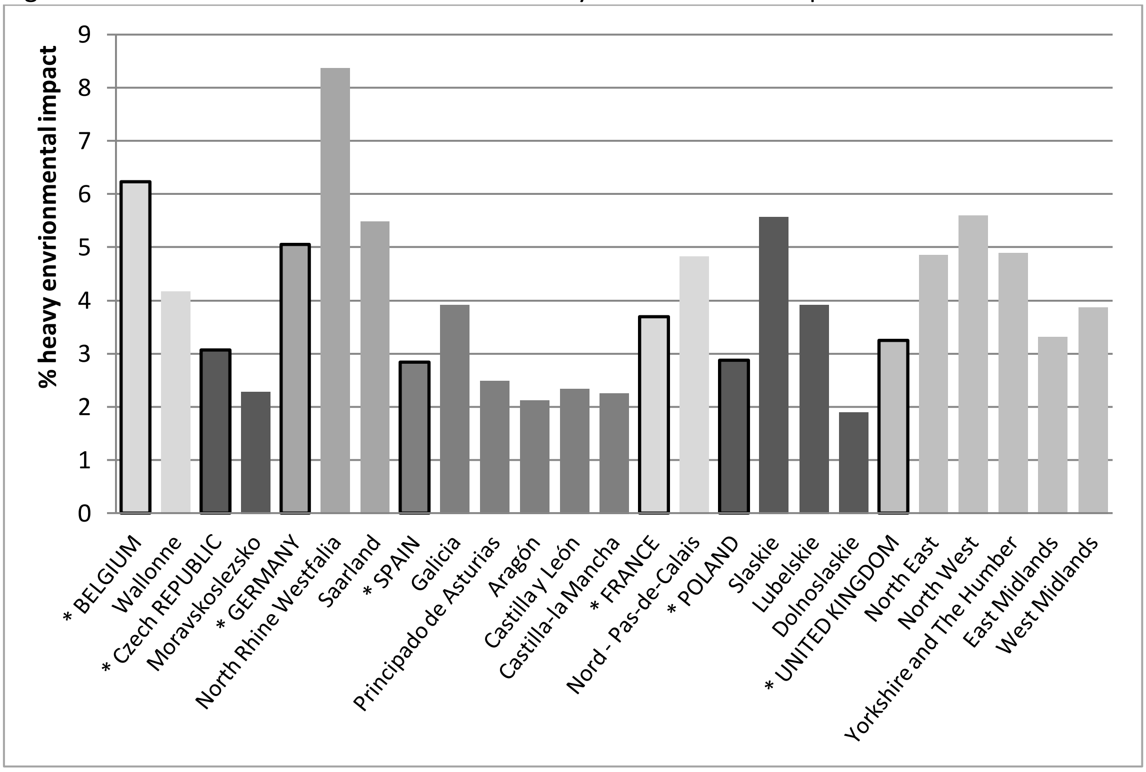
Data source: Eurostat General and Regional Statistics data base

The coalfield regions of: Wallonne (Belgium), Moravskoslezsky (Czech Republic), Castile and Leon and Castilla la Mancha (Spain), Nord-pas-de-Calais (France) Lubelskie (Poland), and all of the English coalfield regions; have greater proportions of their population being at risk of poverty than their mother countries. Both German coalfield regions have similar levels of population at risk of poverty as Germany as a whole, as does the Spanish coalfield region of Galicia. The Slaskie and Dolnoslaskie coalfield regions of Poland have a lower proportion of their populations being at risk of poverty than Poland as a whole. These patterns indicate that the coalfield regions in Belgium, Czech Republic, France and England suffer greater income inequalities compared to their mother country as a whole, while there are mixed pictures of coalfield income inequalities in Poland and Spain. This was also considered a relevant measure of socio economic context at regional scale, which might help to explain the association between health and residence in a coalfield region because it reflects the inequalities which are argued to be important determinants of health.

7.1.3 Quality of natural and built environment

The percentage of land use classified as having heavy environmental impact was chosen as the indicator to give a representation of the quality of the natural and built environment within each region. According to the conceptual framework damage to the environment due to heavy industry might be a disadvantage for health of the resident population. The data were not complete enough to be able to present change over time, but data were available for all coalfield regions in a year which covered the fieldwork of the SHARE survey 2009. As represented in figure 17, the coalfield regions of North Rhine Westphalia and Saarland (Germany), Galicia (Spain), Nord-pas-de-Calais (France), Slaskie and Lubelskie (Poland) and all English coalfield regions except East Midlands; have greater a proportion of their area taken up by land uses with heavy environmental impact than their country as a whole.

Figure 17: Percent of land use classified as heavy environmental impact 2009



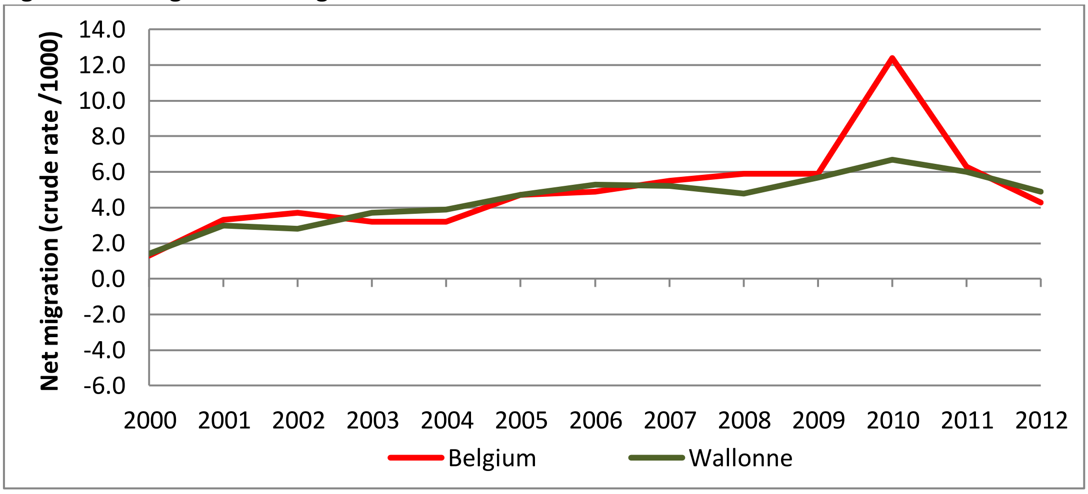
Data source: Eurostat General and Regional Statistics data base

7.1.4 Regional social and economic attractiveness

Net migration was chosen as an indicator of how potentially attractive or otherwise a region may be, in terms of living and working opportunities it offers. Net migration is the difference between the number of immigrants and the number of emigrants into and out of a region and is negative when the number of emigrants exceeds the number of immigrants. Figures 18 to 24 show the trend of net migration for each of the countries in the study.

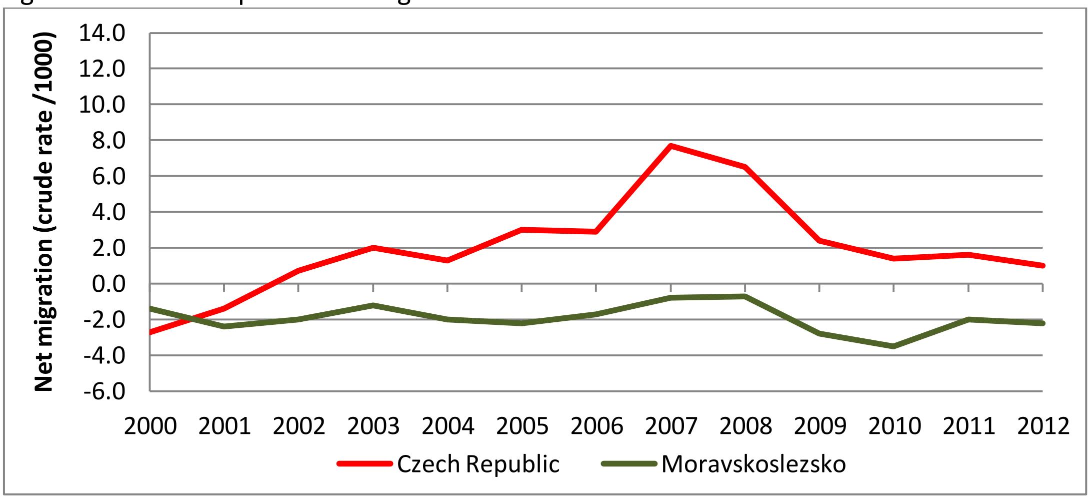
The Belgium coalfield of Wallonne has a similar positive level of net migration to that of Belgium, while the French coalfield region of Nord-Pas-de Calais has negative net migration and is below the positive level of net migration in France. The German coalfield region of North Rhine Westphalia has had a similar fluctuating positive and negative net migration to Germany as a whole, while the region of Saarland has generally had a level of negative net migration below that of Germany. In recent years, although net migration has risen in both coalfield regions to positive levels, they both now have levels below that of Germany as a whole. The coalfield region of Moravskoslezsko in the Czech Republic has a negative net migration rate which has been consistently below the level of the Czech Republic as a whole. The Polish coalfield regions of Slaskie and Lubelskie have consistently had negative net migration rates below that of Poland, while the Dolnoslaskie region has had similar net migration to Poland, for the majority of the time period covered, being stable at or around zero, but in recent years the rate has positive and been above Poland as whole. The English coalfield regions have had a rising level of positive net migration, which started levelling off around 2005. However, all coalfield regions except the East Midlands have net migration rates below that of the UK as a whole. Since 2007, net migration for all coalfield regions in Spain has fallen sharply, as it has done for Spain as a whole, from high positive levels to negative net migration in 2012. The Spanish coalfield region of Castilla-la-Mancha has had the most noticeable fall in net migration, in 2007 the region had the highest net migration rate of all coalfield regions and of Spain as a whole, but in 2012 its net migration fell below Spain, becoming negative and being the lowest of all the coalfield regions.

Figure 18: Belgium Net migration 2000 - 2012



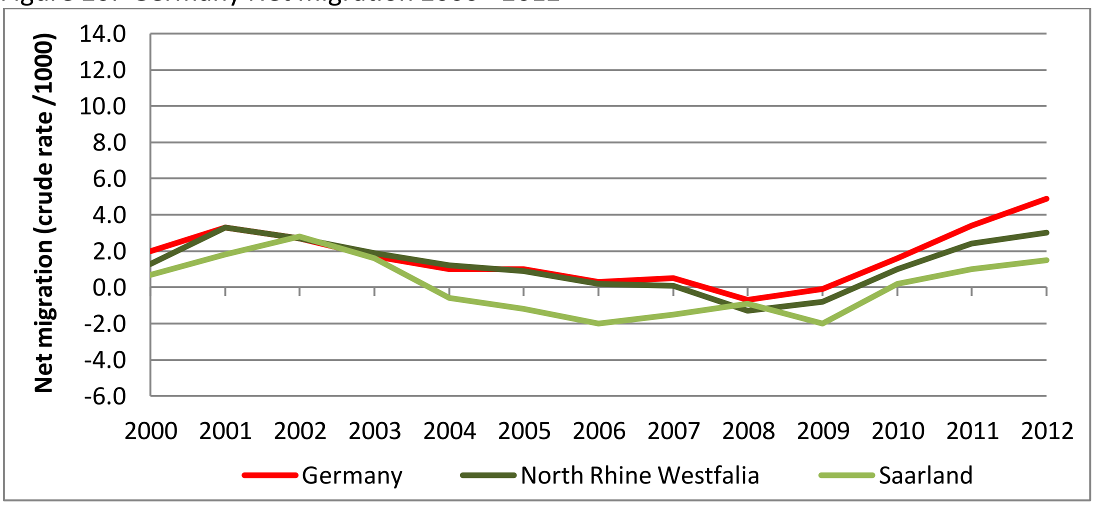
Data source: Eurostat General and Regional Statistics data base

Figure 19: Czech Republic Net migration 2000 - 2012



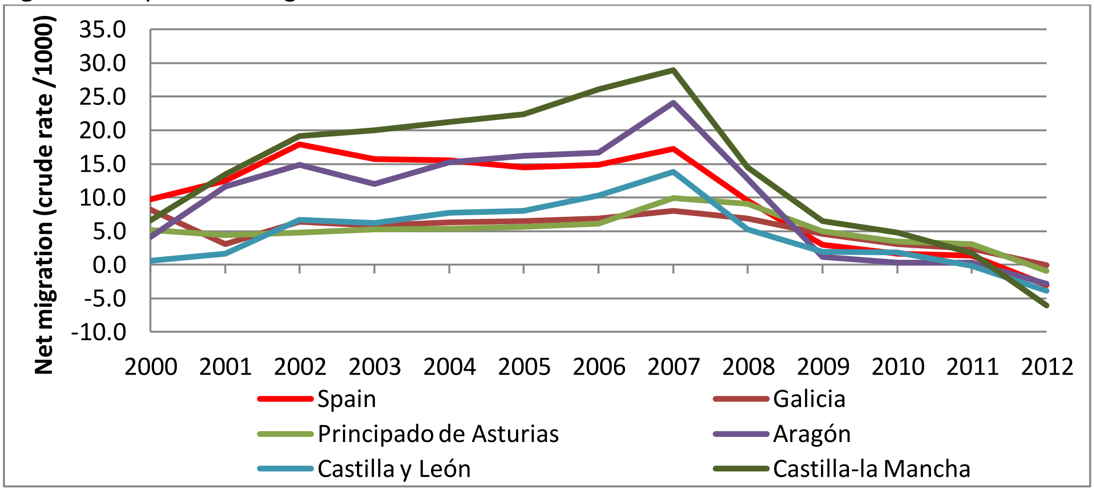
Data source: Eurostat General and Regional Statistics data base

Figure 20: Germany Net migration 2000 - 2012



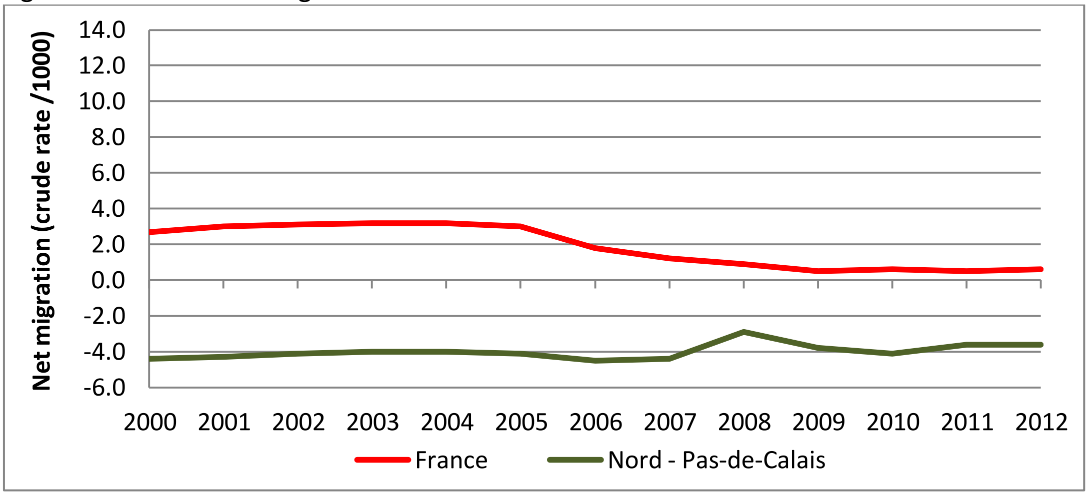
Data source: Eurostat General and Regional Statistics data base

Figure 21: Spain Net migration 2000 - 2012



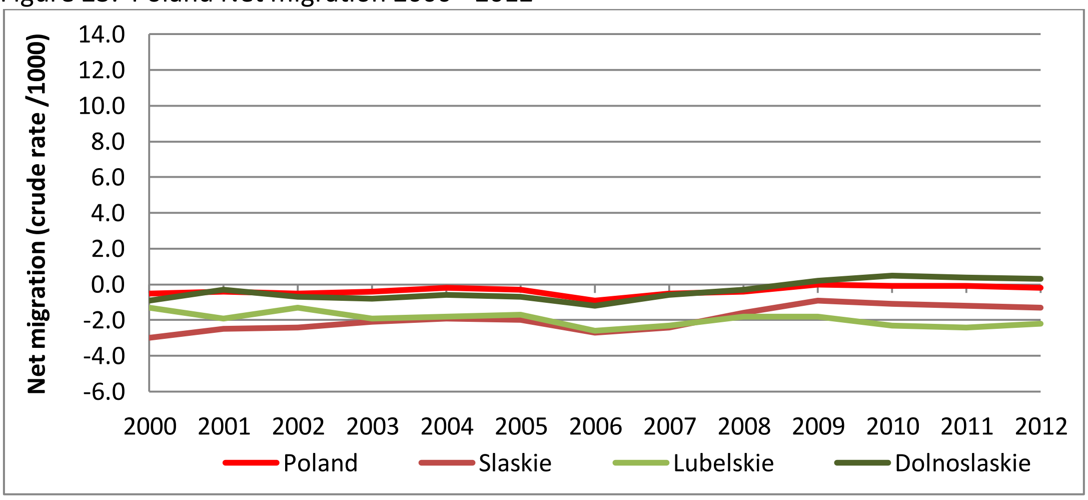
Data source: Eurostat General and Regional Statistics data base

Figure 22: France Net migration 2000 - 2012



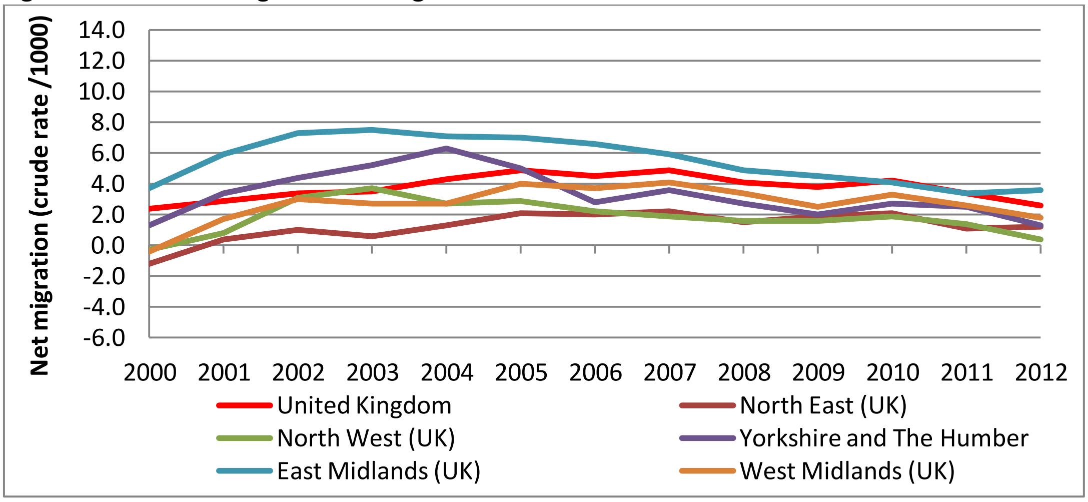
Data source: Eurostat General and Regional Statistics data base

Figure 23: Poland Net migration 2000 - 2012



Data source: Eurostat General and Regional Statistics data base

Figure 24: United Kingdom Net migration 2000 - 2012



Data source: Eurostat General and Regional Statistics data base

7.1.5 Welfare state

A classification of different welfare state regimes is introduced and discussed in Eikemo et al. (2008) and was introduced in this study in table 2 in chapter three, which also allocates each of the countries in this study to their welfare state regime . Differing public policies and welfare state regimes have the potential to influence the health of individuals through the way they shape the socio-economic environment in which people live. As mentioned in chapter two, social-political systems help shape the contextual characteristics of a place and so influence the nature of the wider determinants of health operating in different places. In Eikemo et al. (2008 - 2) there are references to studies which indicate that welfare states are important determinants of health in Europe, through the mediating factors of welfare provision. Social transfers and welfare services are aimed at addressing socio-economic inequalities and therefore influence the extent and impact of socio-economic position on health outcomes. Their study found that approximately 10% of the variation in health between countries was associated with national welfare state characteristics and that Scandinavian (Nordic countries) and Anglo-Saxon (UK (England)) welfare regimes were observed to have better self-perceived general health in comparison to Southern (Spain) and East European welfare regimes (Czech Republic and Poland).

CHAPTER 8

8 Discussion

The preceding chapters presented the results of analyses carried out to address the research questions of this dissertation. In this chapter the implications of the results on our understanding of the issues addressed in this thesis are discussed.

The objectives of the study were framed around the life-course approach to health inequalities, with a conceptual model formulating the idea that differences in health between places are the result of the complex interplay between individual life course events and characteristics and contextual economic, social and environmental factors.

The first objective of this study was to investigate whether there were differences in individual self-reported health between coalfield and non-coalfield regions across Europe, similar to those identified between coalfield and non-coalfield regions in England, (Riva et al. 2011) and also observed in other similar de-industrialised regions in Scotland and in other individual countries across Europe, (Walsh et al. 2008; Mitchell et al. 2011), through different types of study. Once differences had been identified, the second objective of the study was to investigate if selected individual demographic, socio-economic and health risk characteristics contributed to any of the identified health differences between people living in coalfield regions and non-coalfield regions across Europe. The final objective of the study was then to investigate if selected regional contextual characteristics were able to identify if the disadvantage of living in a region with a history of coal mining and heavy industry, influences differences in self-reported health and longstanding illness, over and above the chosen individual factors.

8.1 Are the health differences between groups of individuals in coalfield and non-coalfield areas the same or different across countries within Europe?

The analyses compared health in coalfield regions and non-coalfield regions using information on two health outcomes; self-reported health and self-reported longstanding illness.

The study found, independently of individual demographic, socio-economic and health risk characteristics, there were only weak (at the 10% level) significant differences in the likelihood of individuals reporting poor health between coalfield and non-coalfield regions across the continental European countries, but there were stronger (at the 5% level) significant differences identified in reporting poor health between the English coalfield and non-coalfield regions.

Across the whole dataset, significant differences were found in the likelihood of reporting a longstanding illness between coalfield and non-coalfield regions, independently of individual characteristics, with individuals in coalfield regions being more likely to report a longstanding illness than individuals in non-coalfield regions.

However, further investigation found that the expected health disadvantage, which on average is felt by people living in coalfield areas across Europe, is not consistent across countries; with Poland and to some extent Germany, seemingly having protective effects for those living in coalfield areas.

It is interesting to have identified these cross country differences, and to make an attempt in identify reasons for them. Some possible reasons could be put down to structural or methodological issues with the data and data analysis. Others reasons could possibly be put down to differences in regional social, economic and environmental contextual characteristics or cross country differences social and economic policies.

Firstly to cover some possible methodological issues with the data and data analysis. It has been assumed for the study that the sampling methodologies of the surveys were robust, and that the final samples selected for each country was representative of the total population for each country. However, not accounting for the relative size and representativeness of the samples from different countries in the analysis may have resulted in the European SHARE data not providing enough power to identify health differences between the chosen coalfield and non-coalfield regions, given that in some countries, coalfield regions show a health disadvantage, while in others the reverse is true. If further analysis were to be done, weighting methods would be investigated for the regression analyses, which would give more weight to the relatively under represented regions.

It could also be that the samples from both surveys may not be diverse enough to allow differences in health to be discernible. The survey samples are selected from a population of individuals 50 years and over, so with the sample being generally older, there may be expected to be a higher level of individuals reporting poor health and suffering from a long standing illness. Mortality rates in coalfield regions are also generally higher than in non-coalfield regions resulting is shorter life expectancy. These factors could combine to present populations of over 50 years old in coalfield regions that are deprived of a more diverse sample of people in the older age groups (70-80 and 80+) the section of the population most likely to have experienced conditions when the coal industry was still operating. Individuals in the coalfield regions with poor health may have already died before reaching these older ages, leaving a smaller, and maybe, a selected sample of more healthy resilient and robust individuals, or individuals who were not touched by employment within the coal industry. So when comparing older age groups from coalfield and non-coalfield regions, health differences become less apparent.

Finally, as reported by Mitchell (2005) and Jylha (1998) there may be issues due to cross country (or regional) cultural differences in the way individuals respond to survey health questions. When looking into socio-cultural variations in reporting individual health status, the literature seems to concentrate more on self-reported general health, with little information available on long standing illness. However, Elstad (1996) reports on differences in reporting long standing illness between men in different social classes, and it is possible that similar issues could also cause differences in reporting longstanding illness between different cultures and countries. Elstad (1996) mentions the 'illness iceberg' which suggests that in any random sample, the majority of individuals will have some complaint, symptom or abnormality, but also a large number of these issues will be relatively minor. An individual may have a condition but feels no need to state they are ill, and their decision to mention that illness, or not, may be influenced by their area or country's culture and social factors. For example, in areas of low employment men may be more likely to report illness in order to qualify for unemployment welfare benefits, or 'justify', in a socially acceptable way, their lack of employment. Differences in cultural expectations of health, illness behaviour in recognising illness, interaction between symptoms and other aspects of life may therefore be some of the possible reasons for keeping in mind there may be cross country differences in responses to self-reported health survey questions.

However, looking at the evidence reported in Jylha (1998) there may be signs to suggest that these factors may not necessarily be relevant with respect to differences in self-reported long standing illness. Looking into cultural differences in reporting self-reported health between two areas, one in Finland and the other in Italy, it was found when assessing health in relation to illness and function, patterns of how individuals evaluated their own general health were similar in the different countries and were not completely subjective, but did reflect different dimensions of health, such as diagnosed chronic diseases and functional ability.

So from what is reported in the literature, the picture is not entirely clear on how far membership of different areas and countries influences the nature of responses to survey questions on self-reported longstanding illness. From the assessment of the study data made to ascertain if there were any apparent relationships between country and region type and reporting poor health or a longstanding illness, showed an apparent cross country and within country variation, but it was difficult to say for certain if the patterns were due to cultural differences or are good reflections of true levels of health problems across the countries and regions covered in the study.

The regional social, economic, environmental and country welfare state system contextual differences, which could be possible reasons for cross country differences in the detection of a coalfield effect on health, will be discussed in detail in section 8.3.1 below, and will help address the final study question: how can contextual, socio-economic, political and environmental factors help explain health differences between coalfield and non-coalfield regions? This section will review in detail some possible regional contextual reasons which could help explain the identified protective effect of some coalmining regions in the study. These include the following which may apply in some countries more than others: coalmining may still have a role to play in contributing towards regional wealth and employment; where industrial decline has taken place, its effects may have been lessened by the input of foreign investment towards economic restructuring towards the service sector; the wider region in which the coalmining area sits may be one which has a thriving economy based on other industrial sectors attracting investment and development for urban renewal.

The discussion will move on to the second study question: how far do individual characteristics go towards explaining health differences between coalfield and non-coalfield regions?

8.2 How far are coalfield and non coalfield area health differences associated with demographic, socio-economic and health risk characteristics of the individuals living in these different areas?

The main findings from the bivariate analysis showed that the selected individual demographic, socio-economic and health risk characteristics supported the conceptual framework moderately well for both health outcomes and across all countries.

The results from the multivariate logistic regression analysis indicated that, after controlling for all individual characteristic variables which might explain health variation between coalfield and non-coalfield regions, these did not explain away the 'coalfield effect' (in some cases including data on individual risk factors actually made the 'coalfield effect' appear more pronounced), and that living in a coalfield region was still significantly associated with a greater likelihood of reporting a long standing illness after individual and area variables were introduced into the multivariate model. There was a 30% greater likelihood of reporting a longstanding illness in a coalfield region than a non-coalfield region. The analysis indicated that age group and age left education were the most influential individual predictor variables in 'explaining' the relatively high risk of reporting longstanding illness for those living in coalfield regions. The other individual variables which had a much smaller influence were found to be child health and unemployment.

Age could be confounding the use of age left education as a proxy for social position, if age cohort is a powerful predictor of the likelihood of continuing in education, with older individuals being more likely to be less educated compared to younger age groups, due to changes in social and cultural attitudes and access to education over time, then the true picture of social class influence on health may not be able to be identified in the study. The need to use age left education as a proxy for socio-economic position has been identified as a limitation of the study.

The findings of the multivariate logistic regression analysis suggest that other factors are at play, other than the individual factors examined in this study, in determining the health differences between coalfield and non-coalfield regions. These factors may be other individual characteristics not controlled for in this study, but they could also be due to different regional social, economic and cultural characteristics and histories which individuals have been exposed to over time. As reported in Curtis (2004), health impacts of previous social and economic events in the 1930's were shown to have added to the health impacts on individuals of more recent de-industrialisation.

The following paragraphs cover interesting findings arising from the main focus of the analysis. Across the European data for self-reported health, and the whole dataset for longstanding illness, the data did not support the assumptions that smoking currently would result in greater health risks than not currently smoking; or that having ever been unemployed would result in greater health risks than not ever been unemployed. For the European data set for self-reported health, the data did not support the assumption that working in coalmining or quarrying would offer greater risks to health, than not working in coal mining or quarrying.

When looking into how data from the individual countries supported the conceptual framework, there were some anomalies. Data from Poland and Spain suggested there were protective effects to health by being a current smoker, compared to not being a smoker; and in addition for Poland, the data also suggested there were protective effects for having been unemployed, compared to not having been unemployed.

The length of time individuals had spent resident in their current region consistently had no significant association on health outcomes. This variable was chosen as a marker of how long individuals had been exposed to the social and economic processes and the environmental conditions of their current region, which would have influenced their health through the process mentioned in the study's conceptual framework. It was found in the data preparation process that the majority of individuals, from both surveys and from both coalfield and non-coalfield regions, had lived in their current region for 21 years and over (table 5, chapter three). As most individuals have lived within their current region for a similar amount of time, this may account for the fact that health differences between each of the time frames for this variable have not been identified.

The variation in the association between age left education and longstanding illness across the countries was also interesting. This variable as discussed above, was chosen as a proxy for social class, on this basis the data suggests that in Belgium there is no social class variation in reporting a longstanding illness, while for France, Poland and Spain there is only identified variation for individuals who are more likely to be members of lower social classes, as signified by those who left education under 15 years. For poor health there is significant variation in the likelihood of reporting poor health across the social spectrum in England, the Czech Republic, France and Germany; while in Spain and Belgium there is only identified variation for individuals who are more likely to be members of lower social classes.

These country variations in the relationship between individual characteristics and hypothesised health outcomes, as expected through theory and findings reported in the literature, could help explain why the multivariate regression models explained little of the variation in health between coalfield and non-coalfield areas. Each of the countries within the study potentially have differing cultures and psycho-social processes operating on the individuals within them, so influencing the processes and pathways by which certain individual characteristics could potentially influence health outcome. Combining data from a number of different countries could have the effect of diluting any significant influencing individual characteristics on health, which would otherwise be displayed in an individual country study.

Other reasons why the regression models explain so little of the variation in health could also be down to structural or methodological issues with the data and data analysis. For example; different sample sizes and representativeness of samples for each of the countries from the ELSA and SHARE surveys, and lack of sample diverseness, both of which could have reduced the power of the data in being able to identify health differences between coalfield and non-coalfield regions.

Also, not all life course, social, economic and lifestyle health determinants identified in the literature were able to be used in the regressions model. For example childhood living conditions, childhood economic position, social mobility, resilience, migration. This was due to the lack of available data within the questionnaires, either due to the fact that questions were not asked to obtain the data, data were too incomplete to use or that questions between the SHARE and ELSA surveys were not totally comparable. The use of proxy measures, for example age left education for social class, also resulted in the use of crude approximations and measures of predictor variables. It was hoped that one of the standard classifications could be used to define social economic position of individuals. The SHARE survey used the International Standard Classification of Occupations (ISCO) classification, but no similar variable was available in the ELSA survey, were socio-economic status was classified using the National Statistics Socio-economic Classification.

Finally there are also genetic factors which influence health, which are outside the scope and expertise of this study, to be able to take into consideration. These factors could be influential at the individual or regional and country level.

8.3 How can contextual, socio-economic, political and environmental factors of coalfield areas contribute to health outcomes for individuals living in these areas?

The contextual indicators selected for the study to describe regional social and economic characteristics, were used to see if they could shed any light on possible reasons for the differences between countries and regions.

8.3.1 Situating the study's findings in the light of qualitative literature

The study's conceptual framework indicates that the interaction between individual characteristics and regional contextual characteristics is complex. That there is a multitude of individual life course experiences and conditions which interact with diverse histories of regional and country social, economic, political and environmental conditions, which go to influence health of individuals. Over and above the individual and regional characteristics analysed in this study, it is acknowledged that there are many other social, economic and political factors which could influence the nature of coalfield v non-coalfield differences between countries. Differing living and working conditions, resulting in different exposures to health related hazards. Differing social norms and social structures, influencing health related lifestyle factors such as smoking, harmful alcohol drinking, physical activity and diet. Differing social and cultural traditions influencing social cohesion and resilience, but also possibly enhancing health damaging behaviours.

There seems to be a considerable future research agenda to completely understand the interactions between the individual and the social, economic and political environment they inhabit and their influence on individual health outcomes in coalfield areas of Europe. One line of investigation which could be used to shed light into the reasons for country differences in the relationship between coalfield and non-coalfield region health status, would be to make a full scale intensive study into the economic, political and social histories of countries and coalfield regions, and to search out historical data on labour market and structural and business statistics from individual country statistical agencies.

Although the scale of this line of work is too big to be thoroughly covered in this study, two sources have been used: Walsh et al. (2008) and Siorack (2006), to consider how the findings, relating to the coalfield regions of Poland and France, might be better understood in light of more intensive qualitative studies of particular coalfield areas in these countries. These national settings are of special interest because of the rather contrasting findings reported above for coalfields within their borders.

Walsh et al (2008) reported brief industrial histories of the regions covered in their study, some of which were similar to the regions identified in this study. The southern Poland region of Katowice, covers the Upper Silesian region of Slaskie in this study. Walsh reported that, despite attempts to de-concentrate heavy industry in the early 1950's, under communism, the region was required to increase investment in the traditional coal and steel production, which peaked in the late 1970's, but still in 1994 the region produced 98% of Poland's coal, with employment in the coal industry having increased 23% between 1960 and 1990 (Siorack 2006). In 2005 43% of the work force was still employed in industry and the area remains heavily industrialised, even with the 55% decrease in the number of industrial jobs between 1980 and 2008.

Commentary cited by Siorack (2006) states that 40% of the population in the Silesian region works in industry but 46% in the service sector (at the time of writing in 2006) indicating the restructuring of the economy, through a shift to the service sector and the privatisation of enterprises, changing an image of Silesia dedicated exclusively to coal. This restructuring has been assisted with help from foreign investment into the region, which is second only to that of the Warsaw region. The city of Katowice is the capital of the region, and today is described as being a centre of science, culture, industry, business and transportation in southern Poland and is a rapidly growing metropolitan area.

Commentary in Siorack (2006) also mentions that the region takes second place nationally in terms of the number of students attending higher education and urban renewal is progressing encouraging less pollution, building museums dedicated to mining and reshaping housing in mining areas.

This qualitative approach to describing the contextual character of a coalfield region suggests that although the Slaskie coalfield region of Poland is seeing a loss of jobs from the industrial sector, there is still a relatively strong economic base in the region, and that where there has been the move to re-structure it has been supported financially. The region also has the support of a growing and influential capital city.

Turning to use a more qualitative approach to describe the region, it was interesting to see how well the variables chosen to describe the contextual characteristics of regions for this study mirrored the story of the qualitative approach. It was found that Slaskie's GDP had been consistently above that of Poland as a whole and was higher than the other two Polish coalfield regions, the region's at risk of poverty rate was also lower than that of Poland and the other two coalfield regions. These two indicators together suggest that Slaskie is a relatively wealthy region in Poland and has lower rates of income inequality.

Turning to the relative income inequality theory, which hypothesises that areas with high income inequality suffer increased health and social problems, caused by psycho-social processes acting on individuals Wilkinson and Pickett (2009), it is possible that the fact that

Slaskie is a relatively advantaged place compared to Poland as a whole, there are health protective processes operating in the region. This could help explain why the research found that there was less of a risk of reporting a long standing illness in Polish coalfield regions, compared to non-coalfield regions.

Looking at the other two Polish coalfield regions, it is only Lubelskie which has a lower GDP than Poland as a whole and has a higher at risk of poverty rate than the other two regions and Poland. Looking at land use, Slaskie has the greatest proportion of land use classified as heavy environmental impact, compared with Poland as a whole, and the other two Polish coalfield regions, it also has the highest population density. However, the region's net migration is below that of Poland as a whole and is negative, indicating there are greater numbers leaving the region than coming into it and that its economic activity rate is the lowest of all Poland's coalfield regions and Poland itself.

These points are reflected in the Siorack (2006) commentary, which states that migration and natural negative population growth indicate a problematic demographic situation for the Silesian region. These latter points illustrate Slaskie's densely populated industrial environment, but one whose industrial past is changing highlighted by negative net migration and a low economic activity rate.

Looking at the other two Polish coalfield regions, the contextual data does not show such a distinct picture, but points to note for the Dolnoslaskie region is that its GDP is above that of Poland as a whole, and it's at risk of poverty rate is also below, the same story as for the Slaskie region. The regions net migration however is positive and slightly above Poland as a whole, and its economic activity rate is similar to Poland. It could be said for Dolnoslaskie there are also social and economic protective factors operating in the region, which could influence more positive health outcomes in the region.

Turning to investigate the coalfield story in France, coal mining ceased altogether in this country in 2004. The Nord Pas de Calais mining basin was the largest producer of French coal and held a strategic position at the crossroads of northwest Europe. Commentary within Siorack states that French coal extraction was at its peak during the 1960's, and by 1990 production had fallen by 80% and employment by 90%.

The Walsh study covers the French coalfield region of Nord Pas de Calais, mentioning that since the 1960's there was a move to shift the economic base of the region towards services;

financing, banking, insurance and light manufacturing. However, within the region there is an economic imbalance between the growing Lille metropolitan region and former coalfield based communities.

Looking at the indicators selected to describe contextual characteristics of regions for this study, GDP for Nord Pas de Calais has been consistently below that of France as a whole and the at risk of poverty rate is higher. The latter point could reflect the Walsh commentary in that the income inequalities reflect the economic imbalance between the former coalfield areas within the region and the metropolitan region of Lille. It is interesting to note, that while in the Slaskie region of Poland the dominant metropolitan area of the region seems to be working positively for the social and economic welfare of the coalfield region, the dominant region in Nord Pas de Calais is undermining the social and economic welfare of the region.

These different outcomes would be interesting to investigate further, to find what is driving these two different stories, the findings could then inform policy on how to support declining coalfield regions. However this may not be so easy when trying to apply similar policies and practices within different countries. Poland’s Slaskie region has managed to attract foreign investment, which may be more difficult for France to do for the Nord Pas de Calais region, with a GDP considerably above that of all the coalfield regions.

Commentary in Siorack mentions that the closing down of the French mines caused population movements out of the mining regions. Net migration over the period 2000 to 2012 has been consistently negative for Nord pas de Calais and far below that of France as a whole and the region’s economic activity rate is also much lower than that of France.

It is seen from the data, and illustrated in figure 9, that the proportion of individuals reporting a longstanding illness in the French coalfield region of Nord pas de Calais (60%) is the second highest of all of the French regions. Among the Polish regions, Dolnoslaskie (59%) has one of the lowest rates of reporting a longstanding illness, while Slaskie (65%) and Lubelskie (67%) report near average rates for Poland (67%). These cross country comparisons are interesting as they show that although self-reported health in Nord pas de Calais has a coalfield effect within its own country; health, is better than Slaskie.

Noting the earlier contextual comparison of the Slaskie and Nord pas de Calais regions, it is interesting to see that although Slaskie seemed to be more of a thriving region within its own country, its self-reported health can be deemed poorer than Nord pas de Calais, a region which seemed to be in more of a poorer state economic state within its own country. This illustrates the fact that when comparing health of regions between countries, more than just the contextual factors of each region need to be taken into account, when attempting to find reasons for health differences between regions. The contextual nature of the countries to which the regions belong also needs to be taken into account for example: relative wealth, type of welfare state, social structure, culture, social norms and nature of economic policies.

CHAPTER 9

9 Conclusion

9.1 Contribution to the literature

This study has contributed to the literature by applying the individual life course theory to the evaluation of individual factors and regional contextual factors, which could help explain differences in health between places; and by doing so, used two data sources which had not been used for this type of study before, the Survey of Health and Aging in Europe (SHARE) and the English Longitudinal Study of Aging (ELSA).

The study also adds to the research in the field of comparing health between regions having a mining or industrial heritage, to non-coalmining or industrial regions, in order to try and understand the underlying causes of health inequalities between regions.

With respect to studies of coalfield regions, it additionally adds to the literature by comparing regions across different European countries, and in having done so, interesting findings from the data analysis have added to the literature, through showing apparent 'protective' health effects of living in a coalfield region in Poland and to a lesser extent in Germany. This finding suggests that the wider determinants of health mean different things to health outcomes in different countries and that they are sensitive to the national background within which they are being studied in. The interaction between country social and economic contextual characteristics and individual characteristics should therefore play an important role in the conceptual frameworks of similar studies. The additional short qualitative assessment of two references, against the graphical presentation of selective regional contextual characteristics, was able to shed some light into possible explanations into apparent coalfield protective effects which could be used to inform post-industrial and coalfield regeneration policy making.

9.2 Thoughts on future research

One stand out further analysis using the data would be to carry out a multi-level analysis. The study hypothesis states that health differences between regions is explained by a complex two way interaction between a number of regional and country contextual social, economic and political factors, operating on individuals characteristics over their life course via psychosocial and behavioural processes.

With the study investigating the relationship between individuals and the environment within which they live and work, it would enhance the accuracy of the results to take this into account when applying analytical techniques to the data. If an analysis is carried out only at the individual level and ignores the context in which the individuals reside, there is the possibility that important group level effects will be missed. This problem is referred to as the atomistic fallacy. Carrying out an additional multilevel analysis would benefit this study over and above the multivariate regression analysis which was carried out. Multilevel models calculate the associations between outcomes and predictor variables making assumptions about the distribution of error which allow for the fact that the individuals are grouped within areas. Therefore the characteristics of the area where the person lives is not statistically independent from similar data for others in the sample that live in the same area. Methodologically, multilevel models are more powerful ways to examine 'area effects' and they allow the calculation of what proportion of the total variance in the outcome is associated with variability at the area level, as opposed to variation at the individual level.

It was also felt that the study's assessment of how regional and country contextual characteristics may influence health was hampered due to the lack of availability of historical data from the Eurostat database, with accessible data only going back to 2000. This lost the opportunity to get a feel of each region's contextual social and economic history and the context in which the survey populations would have grown up, worked and lived in.

Ideally it would have been good to have found data going back to at least the early 1970's, a time which marked the start of de-industrialisation for many countries. Even better, would have been the identification of data going back to the 1960's, which would have given a feel for the state of regions in relatively prosperous times and the times when the younger of the survey populations would be growing up as young children and into young adulthood and the older respondents would be in their adult years getting established or settled into family and working life; strengthening the life course approach to the study.

Future research could invest time in approaching the statistical agencies for each country in order to investigate the possibility of obtaining the desired contextual data going back to the 1960's or 1970's. If the data are available, it would also be interesting to extend the investigation to cover a qualitative element. This would identify through the literature, significant cultural and political histories of the coalfield regions and of the wider country political influences and welfare systems. This would in turn enable a more thorough investigation of the contextual factors influencing the wider determinants of health within coalfield regions and non-coalfield regions within the same country, and also within coalfield regions across different countries.

The robustness of the findings in this study will also be influenced by how the coalfield regions were defined. The study was always going to be restricted to high level geographies, due to the availability of geographical data from the surveys. A possibility for future research would be to investigate the possibility of using lower level local administrative geographies, which would offer a better level of granularity for matching more closely the boundaries of the identified coalfields regions. There exists the possibility of obtaining contextual data for smaller geographies such local authorities in England, Kreis in Germany and Departments in France, direct from statistical authorities of each individual country. However, obtaining individual level data at lower geographies will be more problematical, as the cost of surveys usually restricts the size of survey samples to that which are only robust to analyse at country or regional level at the most. Any future study would probably have to go to the expense of designing and administering its own survey, as surveys which cover the life course, or are longitudinal in nature and ask questions consistently between different countries, are not available to cover lower level geographies.

9.3 Thoughts on policy recommendations

The findings from the study suggest there are a number of factors which can account for differences in population health between different types of places.

The study showed that the country coalfields were located in had a role to play in whether there were significant health differences between coalfield and non-coalfield regions and in what direction the difference was. For Poland there was a coalfield region protective factor towards health, while in England, Belgium and France poorer health was reported in coalfield regions.

From two case studies of coalfield regions in Poland and France it was hypothesised that relative wealth of the coalfield regions within their own countries could be the explanation for the differences in health found between coalfield regions and non-coalfield regions.

Implications for policy are that countries should attempt to give support to coalfield regions in order for them to re-structure and move away from the reliance of a declining industry. The nature of this support could be in the form of financing, but this should be preceded by robust planning as the support needs to enable continual sustainable re-development. Some regions may be in a better position to respond to re-structuring due to their geographical location or skill mix. There will be need for specific development policies tailored for the different needs of regions, there potentially will also be different needs between countries, so it may not be possible to say because one policy worked in one region or country it will work in another.

At the population level it was found that age, child health and social position (as measured by age left education) accounted most for explaining the difference in health of individuals in coalfield and non-coalfield regions. There is strong evidence that a child's experience in their early years has a major impact on the health and life chances as children and adults (Galobardes et al. 2004). How well a child grows in terms of their physical, social and emotional, cognitive and speech and language development, is a predicator of educational outcomes in young adulthood, which in turn is related to long-term health outcomes. Early life experiences are also seen to have lasting effects on adult health both directly and through influencing health behaviours, for example excess exposure to alcohol and suffering emotional and physical neglect during early years of life lead to poor physical and psychological development (Solis et al. 2015) and so affecting later life chances. This suggests that investing in social policies which aim to improve child health will help to improve the health prospects of individuals as they advance into their adult years.

The study suggested that age cohorts go through specific conditions which influence the health outcome of that specific age cohort. The younger ages in the study it seems had the greatest health differences between coalfield and non-coalfield regions. Health promotion and health interventions aimed at these younger age groups may benefit them as they move into older age, although their specific health needs will need to be identified first, something this study did not identify.

APPENDIX 1: Definitions of region contextual variables

Gross domestic product (GDP) by purchasing power standard (PPS) per inhabitant

The regional gross domestic product data is calculated by Eurostat from data provided to them by member state statistical authorities, and are estimates based on a harmonized methodology. Figures for gross value added at basic prices, after correction for financial intermediation services indirectly measured (FISIM), are used as the basic variable for the estimates. The conversion to PPS is based on national purchasing power parities which are regularly calculated by Eurostat. Purchasing Power Standards (PPS) are a fictive currency unit that eliminates differences in different price levels between countries. Figures expressed in Purchasing Power Standards are derived from figures expressed in national currency by using Purchasing Power Parities (PPP) as conversion factors. These parities are obtained as a weighted average of relative price ratios in respect to a homogeneous basket of goods and services, for each country. They are fixed in a way that makes the average purchasing power of one Euro in the European Union equal to one PPS. The calculation of GDP in PPS is intended to allow the comparison of levels of economic activity of different sized economies irrespective of their price levels. Trend data was available between 2000-2011 from the Eurostat regional and economic accounts tables in the regional statistics database.

Land use of heavy environmental impact

The data source for this land use indicator is Eurostat's The Land Use/Cover Area frame Survey (LUCAS). The survey is carried out every three years, with 2009 being the most recent LUCAS survey that covers the SHARE and ELSA survey fieldwork years. The Land use statistic indicates the socioeconomic use of land, for example; agriculture, forestry, recreation or residential use. The heavy environmental impact land use category consists of: industry, mining and transport. The indicator is calculated as a percentage of total land use measured in square km. The most common land use among the heavy environmental impact sub-categories, was for transport, which averaged some 70 % of the total land use within this category; mining accounted for 11 % of the total for this category[1]. Data is available from the Eurostat Land cover/use statistics (LUCAS).

1. From: Land cover, land use and landscape: http://ec.europa.eu/eurostat/statistics-explained/index.php/Land_cover,_land_use_and_landscape [14/01/15]

At risk of poverty rate

The source of the date for the indicator comes from the European Union Statistics on Income and Living Conditions (EU-SILC) survey which is coordinated by Eurostat. It collects data on income, poverty, social exclusion and living conditions from the EU member states. EU-SILC. The at-risk-of-poverty rate is a relative measure of income inequalities, rather than a direct measure of poverty. It is defined as the percentage of the population with an equivalised disposable income (after social transfers) below the at-risk-of-poverty threshold, which is set at 60 % of the national median equivalised disposable income. The total household income is equivalised to take into account the impact of differences in household size and composition. The equivalised disposable income of a household is defined as the sum of all the incomes of all its members divided by its equivalised number of members, defined by the following: 1 for the survey household's 1st adult, 0.5 for each other adult and 0.3 for each child less than 14 years. The choice of the poverty threshold at 60% of the national median represents the level of income that is considered necessary to lead an adequate life. It should be noted that cross-country comparisons of relative poverty measures, such as the at-risk-of-poverty rate, should be done carefully, as relative poverty levels have to be analysed jointly with national poverty thresholds in order to avoid misinterpretations.

The at risk of poverty rates for Germany, England and France are estimates. Data is for 2009, as data were incomplete for the preferred year of 2007 and also for 2008. Data was extracted from the Eurostat regional poverty and social exclusion statistics in the regional statistics database. The indicator is a percentage measure.

Net migration

Net migration is the difference between the number of immigrants and the number of emigrants into and out of a region. Net migration is negative when the number of emigrants exceeds the number of immigrants. Eurostat produces net migration figures by taking the difference between total population change (the difference between the size of the population at the end and the beginning of the period) and natural change (the difference between the number of live births and the number of deaths during the year). The measure is a crude rate of net migration per 1000 population. Trend data was available for 2000 to 2012 from the Eurostat regional and economic accounts tables in the regional statistics database.

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